Southern IFCA Survey Report

Solent Bivalve Survey 2023

1 Introduction

The Solent Bivalve Survey runs twice a year to assess the distribution and abundance of bivalve species in three Bivalve Management Areas (BMA) defined under the Solent Dredge Permit Byelaw, namely Area 4 (Southampton Water), Area 5 (Portsmouth Harbour), and Area 6 (Langstone Harbour). The spring survey provides information on the stock following the closure of the fishing season and the autumn survey on the stock prior to the opening of the fishing season in November.

The survey focuses on the two main bivalve species harvested commercially in these Management Areas, the Manila clam (*Ruditapes philippinarum*) and the Common Cockle (*Cerastoderma edule*). The results from the survey provide data which can be used as a baseline against which to monitor trends in stock levels of commercial bivalve species in the Solent, which will feed into the future development of management for the Solent Dredge Permit Fishery.

2 Methodology

In 2023, the Spring survey took place from the 3rd April to the 5th April and the Autumn survey over three days between the 14th and 18th of September, using three local fishing vessels familiar with the BMA being sampled by that vessel. On each vessel, the same box clam dredge was deployed, of the same class used in normal fishing practice (Figure 1).

Each management area has defined survey sites which represent areas of different fishing intensity and habitat type. The areas surveyed also span a range of classifications for shellfish beds as defined by the Food Standards Agency. The survey sites for each management area are shown in Figure 2.

Figure 1. Photo of the box clam dredge used in the survey.

Shellfish samples were obtained using the following methodology:

- Three dredge tows, timed at two minutes, were conducted within each survey site within the wider BMA.
- After two minutes the dredge was brought inboard and any bivalves within it were retained.
- The presence/abundance of different sediment types and other habitat identifiers including weed and slipper limpet (*Crepidula fornicata*) were recorded and abundance scored on a scale of 1 - 5.

- Each bivalve was identified to species level and the first 50 individuals of each species were measured along the widest axis (length) to the nearest millimetre.
- Manila clams and Common cockles were separated into at/above and below their Minimum Conservation Reference Size (MCRS), 35mm and 23.8mm respectively, and then weighed.
- All samples were returned to shellfish production areas with the same classification as that from which they had been taken after measuring.

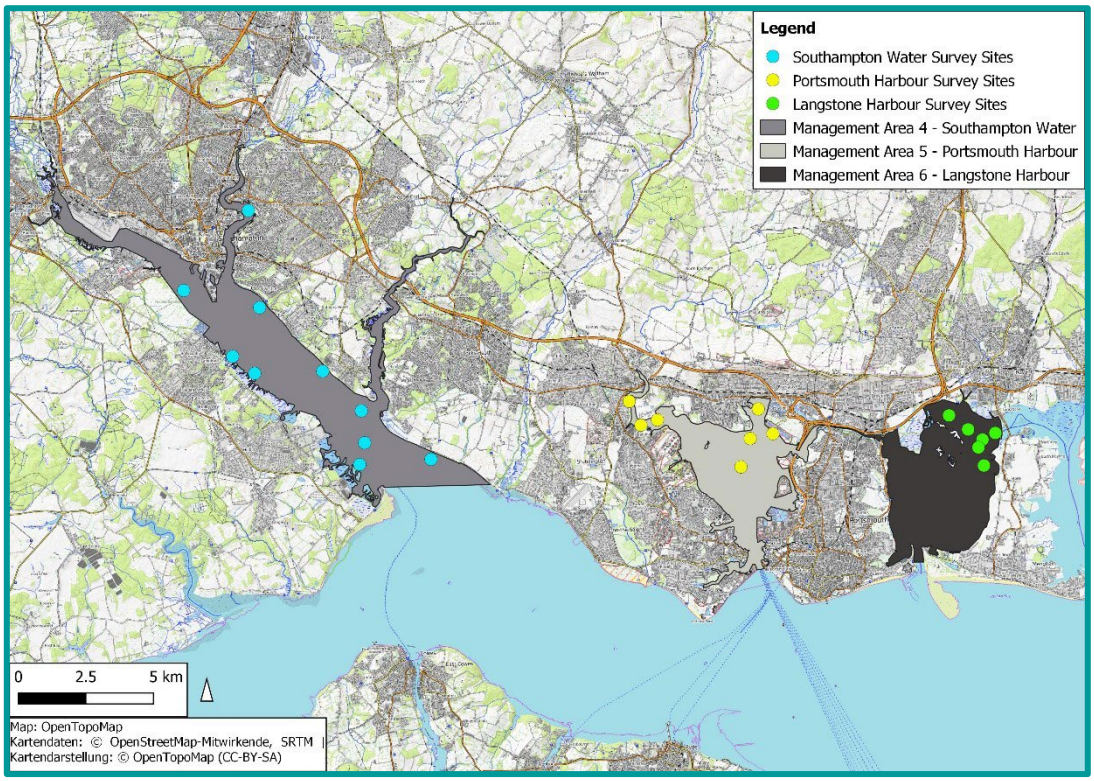

Figure 2: Map showing each of the three management areas surveyed and the location of survey sites within each area.

3 Results

The results of the survey focus on the two main commercial species, the Manila clam and the Common cockle.

Other species found during the survey in smaller quantities included the American Hard-Shelled clam (*Mercenaria mercenaria*), the native oyster (*Ostrea edulis*), the Pacific oyster (*Magallana gigas*), and the spiny cockle (*Acanthocardia aculeata*).

3.1 Catch Per Unit Effort

Data on the abundance and distribution of Manila clam and Common cockle is presented as Catch Per Unit Effort (CPUE), defined as kg of shellfish per metre of dredge per hour, for each BMA. CPUE is provided for both species at/above Minimum Conservation Reference Size (MCRS) and below MCRS. The use of CPUE consistently between survey years and pre/post fishing seasons allows for statistical comparisons to identify if there are any significant changes to the stock of the two focus species.

It should be noted that, given that the sampling method is size selective, data for stock below MCRS will not be representative of the full portion of the stock of each species in these size classes, however consistency in survey methodology between years allows for comparisons.

3.1.1 Comparison between pre and post the fishing season

CPUE data from Autumn 2022, as a representation of pre-fishing conditions, has been compared to CPUE data from Spring 2023, as a representation of post-fishing season conditions, for each management area considering CPUE at/above MCRS and below MCRS.

Manila clam

- For Southampton Water, a Dunn's post-hoc analysis found no statistically significant difference in CPUE at/above MCRS or below MCRS between the Autumn 2022 survey and the Spring 2023 survey.
- For Portsmouth Harbour, a Dunn's post-hoc analysis found no statistically significant difference in CPUE at/above MCRS or below MCRS between the Autumn 2022 survey and the Spring 2023 survey.
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference in CPUE at/above MCRS or below MCRS between the Autumn 2022 survey and the Spring 2023 survey.

Common Cockle

- For Southampton Water, a Dunn's post-hoc analysis found no statistically significant difference in CPUE at/above MCRS or below MCRS between the Autumn 2022 survey and the Spring 2023 survey.
- For Portsmouth Harbour, a Dunn's post-hoc analysis found no statistically significant difference in CPUE at/above MCRS between the Autumn 2022 survey and the Spring 2023 survey. A Dunn's post-hoc analysis found that the CPUE below MCRS was statistically significantly higher in Spring 2023 than Autumn 2022 ($p < 0.05$) (Figure 3).
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference in CPUE at/above MCRS or below MCRS between the Autumn 2022 survey and the Spring 2023 survey.

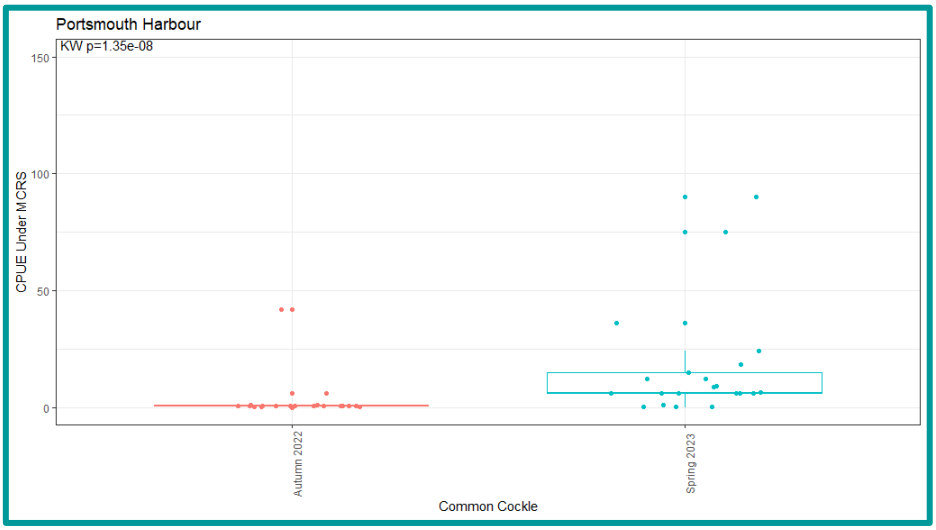

Figure 3: CPUE of Common Cockle below MCRS for Portsmouth Harbour between the Autumn 2022 and Spring 2023 surveys, which were found to statistically significantly different ($p<0.05$).

3.1.2 Comparison between surveys run in 2023

A comparison between the Spring 2023 and Autumn 2023 surveys was carried out to analyse changes to population levels during the fishery closed season.

Manila clam

- A Dunn's post-hoc analysis found no statistically significant differences in CPUE at/above or below MCRS between the surveys run in 2023 for any of the BMAs.

Common Cockle

- For Southampton Water, a Dunn's post hoc analysis found that CPUE at/above MCRS was statistically significantly higher in Autumn 2023 in comparison to Spring 2023 ($p < 0.05$) (Figure 4). No statistically significant differences were found between 2023 surveys for CPUE below MCRS.
- For Portsmouth Harbour, no statistically significant differences were found between 2023 surveys for CPUE at/above MCRS. A Dunn's post-hoc analysis found that CPUE below MCRS was statistically significantly lower for Autumn 2023 in comparison to Spring 2023 ($p < 0.01$) (Figure 5).
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference between 2023 surveys in CPUE at/above MCRS or below MCRS.

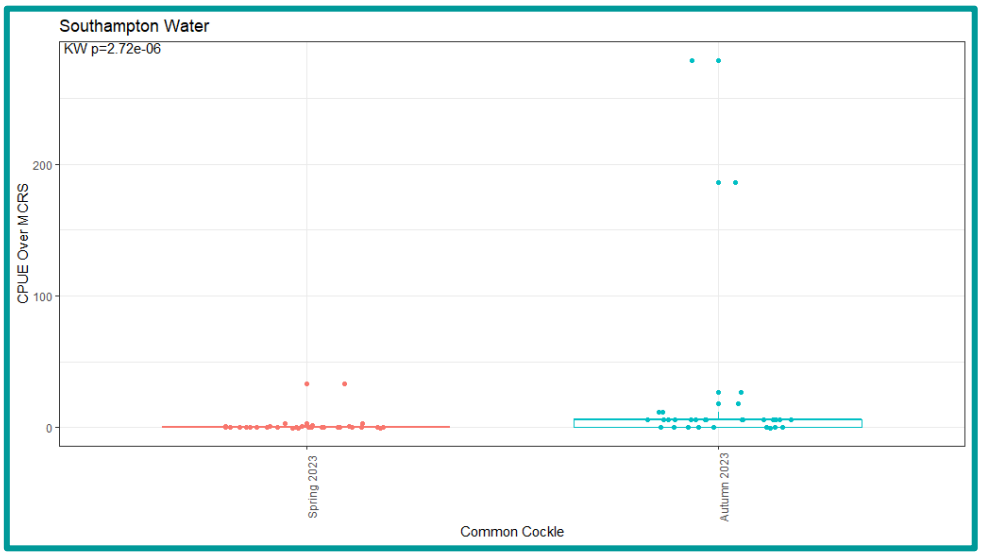

Figure 4: CPUE of Common Cockle at/above MCRS for Southampton Water between the Spring 2023 and Autumn 2023 surveys, which were found to be statistically significantly different ($p<0.05$).

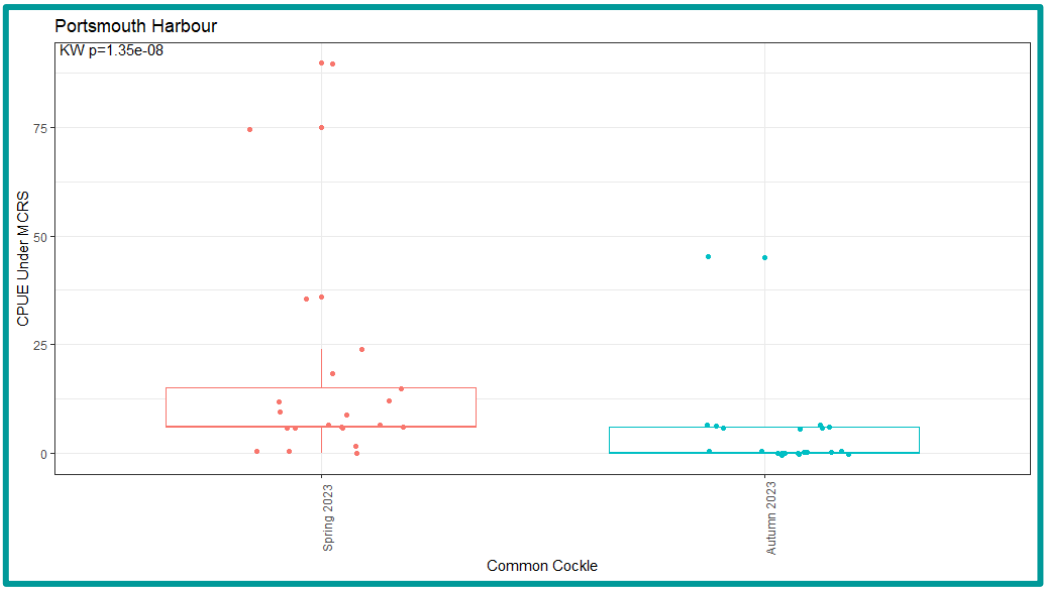

Figure 5: CPUE of Common Cockle below MCRS for Portsmouth Harbour between the Spring 2023 and Autumn 2023 surveys, which were found to statistically significantly different (p<0.01).

3.1.3 Comparison between survey years for spring (post-fishing season) surveys

- CPUE data for surveys carried out in the spring, representing post-fishing season conditions, has been compared between survey years.
- For Manila Clam CPUE data is available for 2018 – 2020 and 2022 – 2023, however data from Spring 2018 has been removed due to there being no weight data available, weight data was only obtained from autumn 2018 onwards through development of the survey methodology. For Common cockle CPUE data is available for 2020, 2022, and 2023 (weight data for Common cockle was not collected prior to 2020). Please note there is no survey data available for spring 2021 due to the Covid-19 pandemic.

Manila clam

- For Southampton Water, no statistically significant differences were found between spring surveys for CPUE at/above MCRS. A Dunn's post-hoc analysis between data from Spring surveys in 2019, 2020, 2022, and 2023 found that CPUE under MCRS was statistically significantly higher in Spring 2020 in comparison to Spring 2023 (p < 0.01) (Figure 6).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found no statistically significant difference between years in CPUE at/above MCRS or below MCRS.
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference between years in CPUE at/above MCRS or below MCRS.

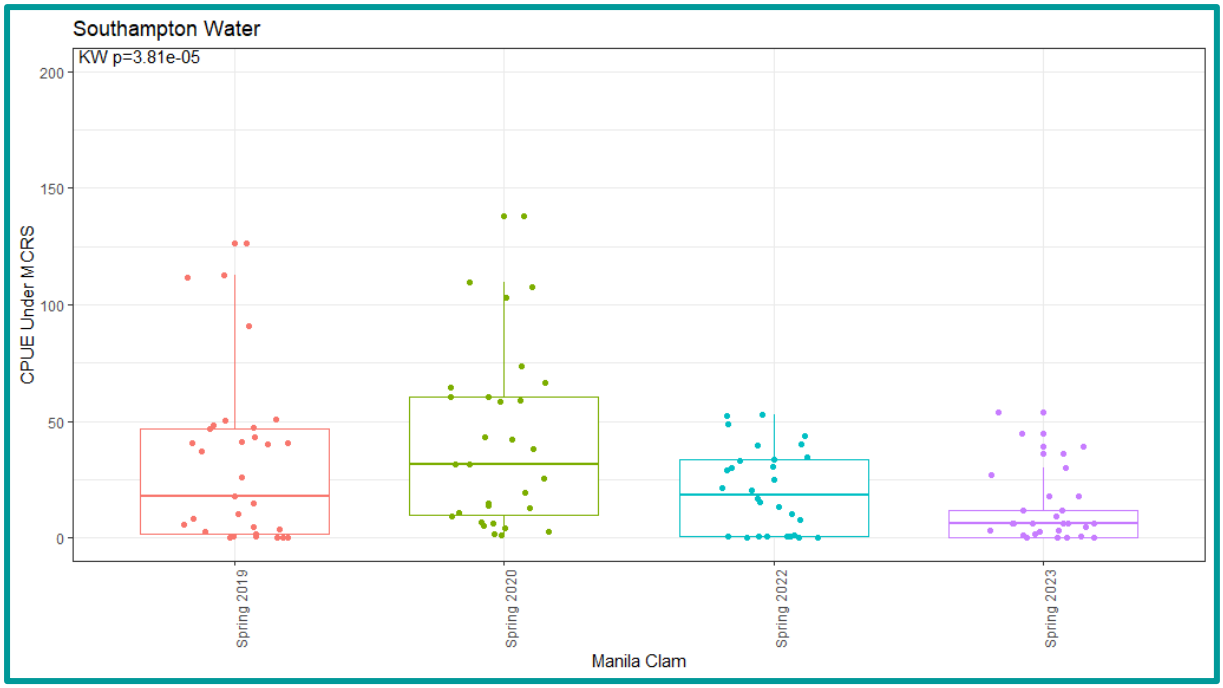

Figure 6: CPUE of Manila Clams below MCRS from Southampton Water for available spring surveys from 2019 to 2023, where a significant decrease ($p < 0.01$) was found between 2020 and 2023.

Common Cockle

- For Southampton Water, a Dunn's post-hoc analysis between data from Spring surveys in 2020, 2022, and 2023 found that CPUE at/above MCRS was statistically significantly higher in Spring 2020 ($p < 0.01$) and in Spring 2022 ($p < 0.01$) in comparison to Spring 2023 (Figure 7). No statistically significant difference was found between years in CPUE below MCRS.
- For Portsmouth Harbour, a Dunn's post-hoc analysis found that CPUE at/above MCRS was statistically significantly higher in Spring 2020 ($p < 0.05$) and in Spring 2022 ($p < 0.01$) in comparison to Spring 2023 (Figure 8). No statistically significant difference was found between years in CPUE below MCRS.
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference between years in CPUE at/above MCRS or below MCRS.

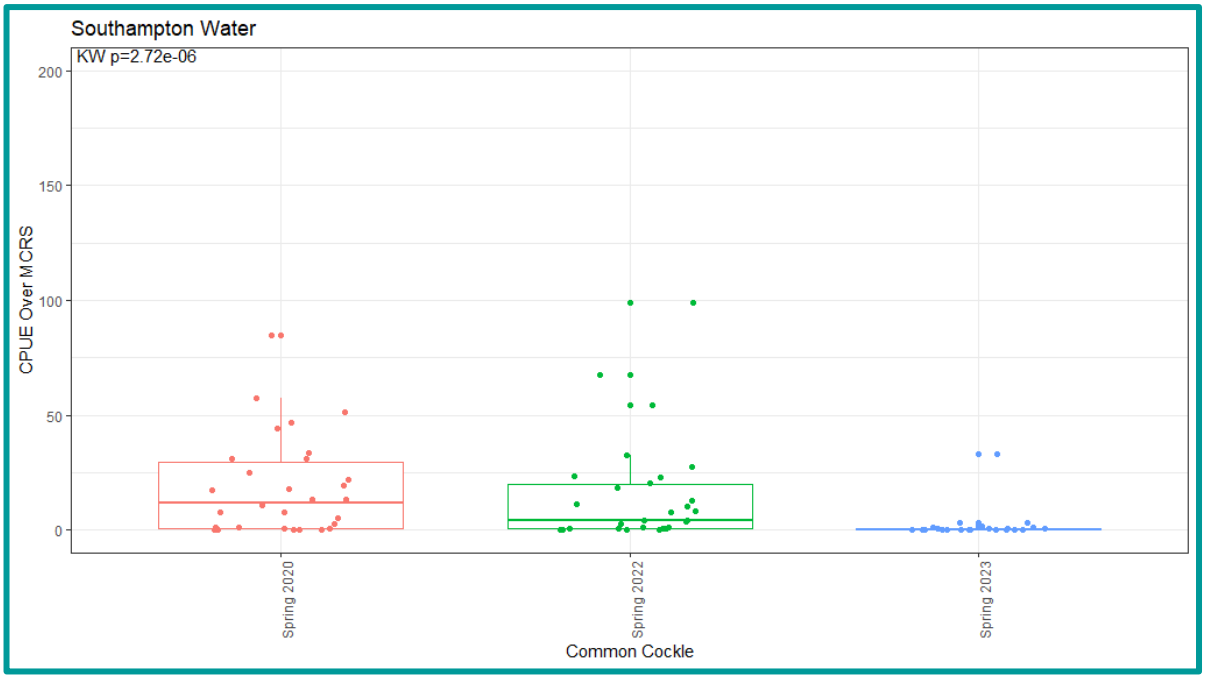

Figure 7: CPUE of Common Cockle at/above MCRS from Southampton Water for spring surveys, where statistically significant decreases ($p < 0.01$) were found from 2020 and 2022 to 2023.

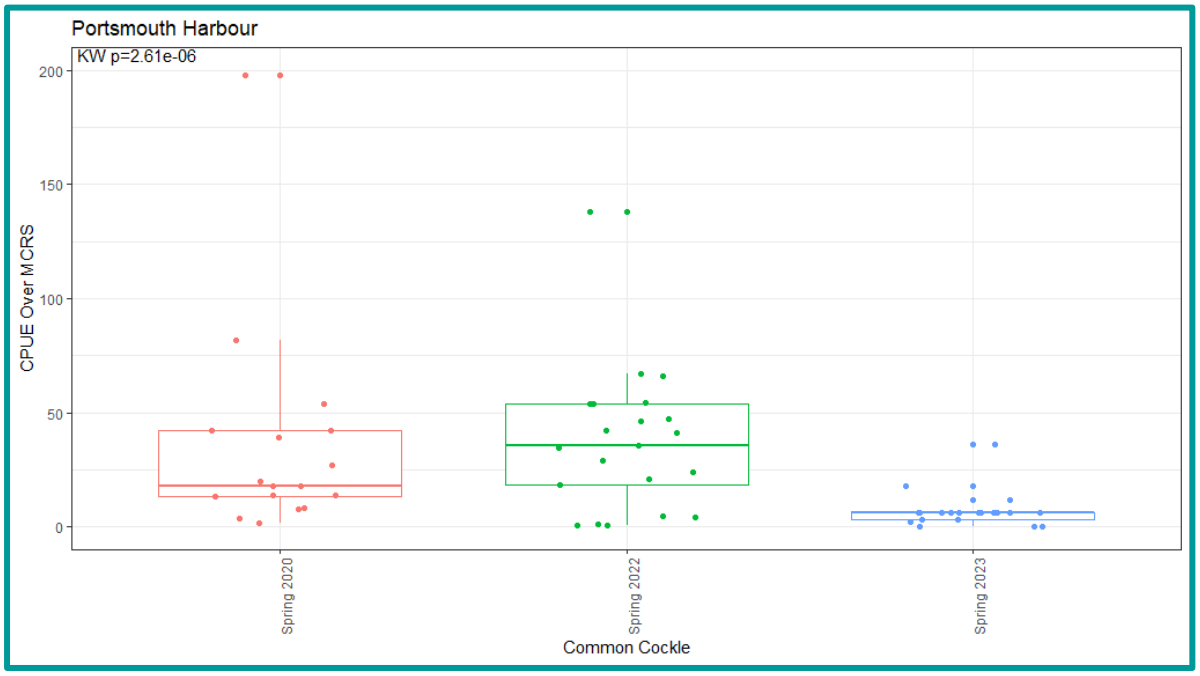

Figure 8: CPUE of Common Cockle at/above MCRS from Portsmouth Harbour for spring surveys, where statistically significant decreases ($p < 0.01$) were found from 2020 and 2022 to 2023.

3.1.4 Comparison between survey years for autumn (pre-fishing season) surveys

- CPUE for surveys carried out in the autumn, representing pre-fishing season conditions, has also been compared between survey years.
- For Manila clams, CPUE data is available for 2018, 2019, 2021, 2022 and 2023. For Common cockles, CPUE data is available for 2021, 2022, and 2023 (weight data was not

collected prior to 2020). No data was collected in autumn 2020 due to the Covid-19 pandemic.

Manila Clam

- For Southampton Water, no statistically significant differences were found between autumn surveys for CPUE at/above MCRS. A Dunn's post-hoc analysis between data from Autumn surveys in 2018, 2019, 2021, 2022, and 2023 found that CPUE below MCRS was statistically significantly higher in Autumn 2019 in comparison to Autumn 2021 ($p < 0.01$) and Autumn 2023 ($p < 0.05$) (Figure 9).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found no statistically significant difference between years in CPUE at/above MCRS or below MCRS.
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference between years in CPUE at/above MCRS or below MCRS.

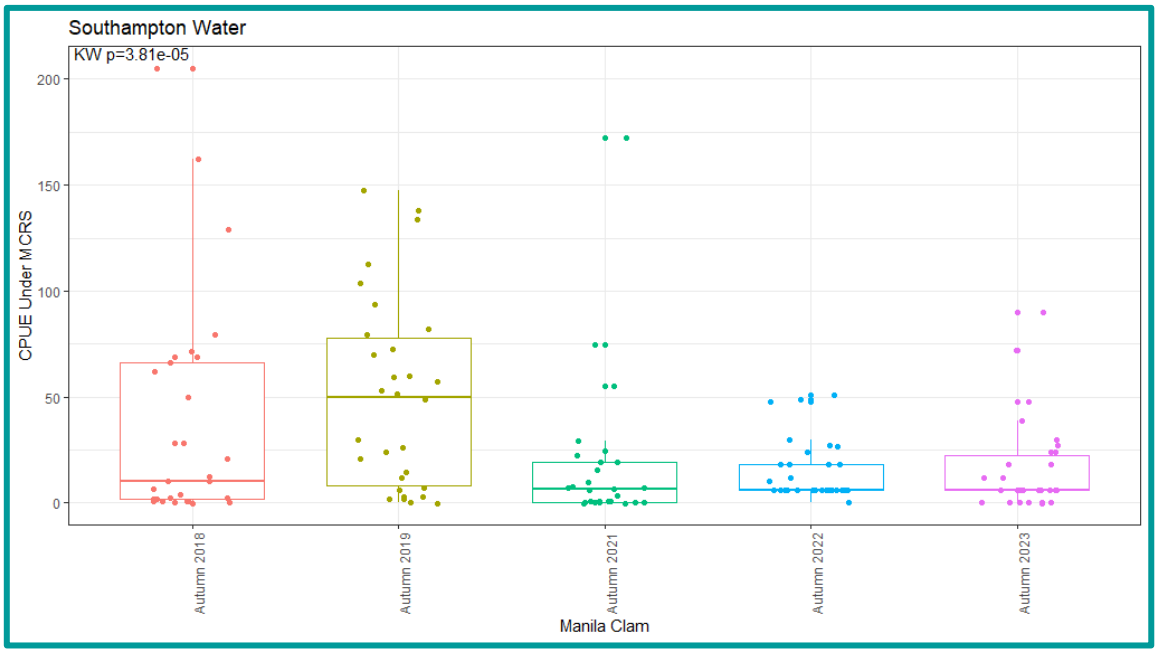

Figure 9: CPUE of Manila Clams below MCRS from Southampton Water for autumn surveys, where statistically significant decreases were found from 2019 to 2021 ($p < 0.01$) and 2023 ($p < 0.05$).

Common Cockle

- For Southampton Water, no significant differences were found between spring surveys for CPUE at/above MCRS. A Dunn's post-hoc analysis between data from Autumn surveys in 2021, 2022, and 2023 found that CPUE below MCRS was statistically significantly higher in Autumn 2021 in comparison to Autumn 2022 ($p < 0.05$) (Figure 10).
- For Portsmouth Harbour, analysis between data from Autumn surveys in 2021, 2022, and 2023 found that CPUE at/above MCRS was statistically significantly higher in Autumn 2021 in comparison to Autumn 2023 ($p < 0.05$) (Figure 11). A Dunn's post-hoc analysis found no statistically significant difference between years in CPUE below MCRS.
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference between years in CPUE at/above MCRS or below MCRS.

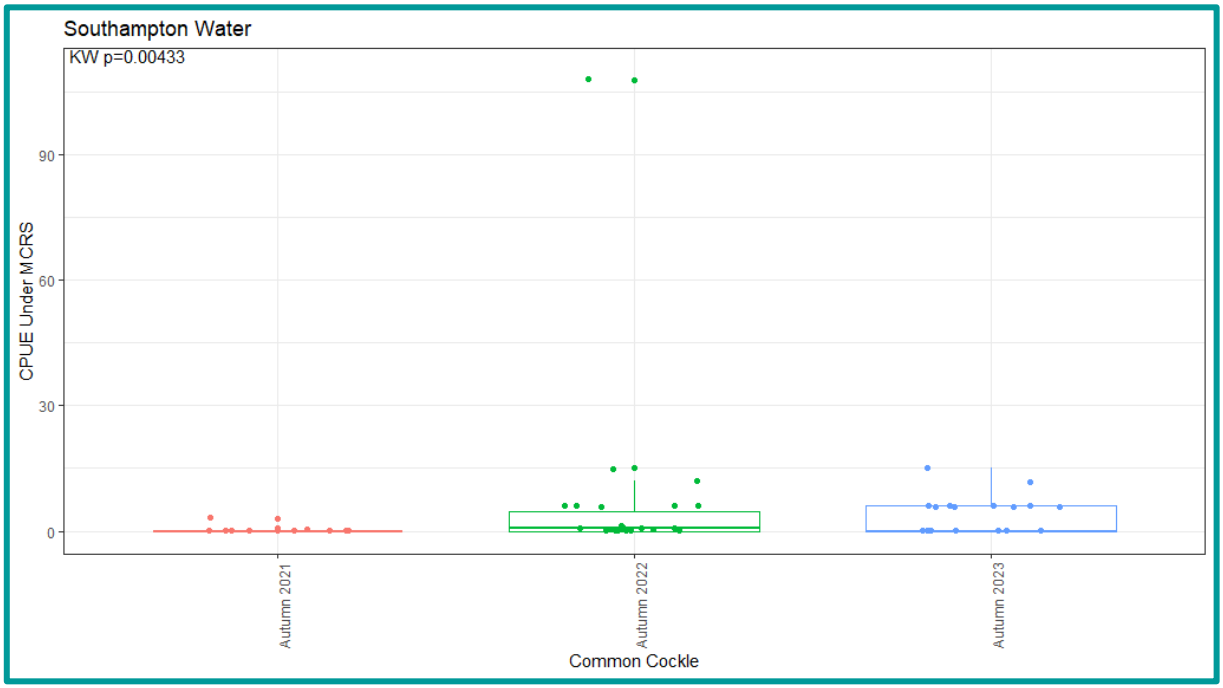

Figure 10: CPUE for Common Cockle below MCRS in Southampton Water for autumn surveys, where a significant decrease ($p < 0.05$) was found from 2021 to 2022.

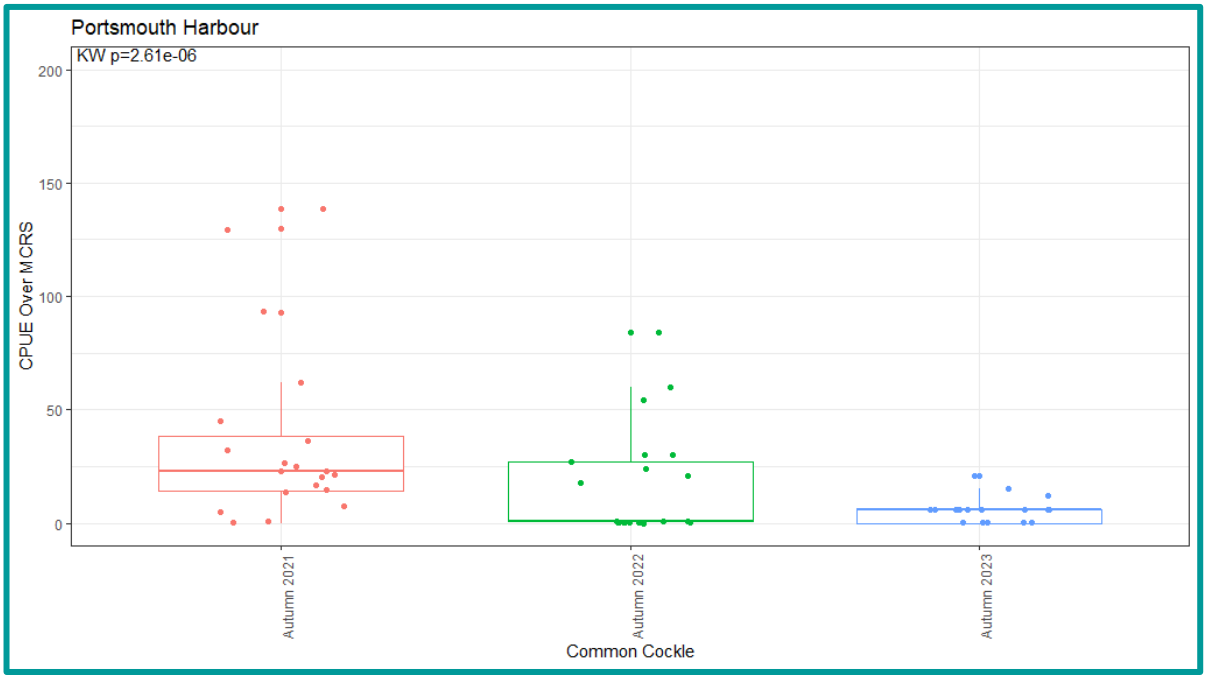

Figure 11: CPUE for Common Cockle at/above MCRS in Portsmouth Water for autumn surveys, where a significant decrease ($p < 0.05$) was found from 2021 to 2023.

3.2 Average Length

An analysis on the length trends within the data collected in 2023 and the data within the survey timeseries was undertaken. Given the lack of general trend observed within the results of this analysis, presented here is the occurrence of average length above or below MCRS within each BMA. The full comparative results for analysis of length data between pre- and post- fishing season, surveys undertaken in 2023, surveys undertaken post-fishing season (Spring), and surveys undertaken pre-fishing season (Autumn) are available within Annex 1.

3.2.1 Surveys undertaken pre and post fishing season (2022 to 2023)

Manila Clam

- For Southampton Water, both the Autumn 2022 survey and the Spring 2023 survey had average lengths below MCRS (35mm), at 33.11mm and 33.82mm respectively.
- For Portsmouth Harbour, the Autumn 2022 survey had an average length below MCRS at 33.29mm while the Spring 2023 survey had an average length above MCRS at 36.36mm.
- For Langstone Harbour, both the Autumn 2022 survey and the Spring 2023 survey had average lengths above MCRS, at 38.74mm and 37.04mm respectively.

Common Cockle

- For Southampton Water, both the Autumn 2022 and the Spring 2023 surveys had average lengths above MCRS (23.8mm), at 26.84mm and 26.77mm respectively.
- For Portsmouth Harbour, both the Autumn 2022 and the Spring 2023 surveys had average lengths above MCRS, at 25.47mm and 27.5mm respectively.
- For Langstone Harbour, both the Autumn 2022 and the Spring 2023 surveys had average lengths above MCRS, at 29.42mm and 26.96mm respectively.

3.2.2 Surveys run in 2023

Manila Clam

- For Southampton Water, both the Spring 2023 and the Autumn 2023 survey had average lengths below MCRS (35mm), 33.82mm and 32.76mm respectively.
- For Portsmouth Harbour, both the Spring 2023 and the Autumn 2023 surveys had average lengths above MCRS, at 36.36mm and 35.84mm respectively.
- For Langstone Harbour, both the Spring 2023 and the Autumn 2023 survey had average lengths above MCRS, at 37.04mm and 37.7mm respectively.

Common Cockle

- For Southampton Water, both the Spring 2023 and the Autumn 2023 surveys had average lengths above MCRS (23.8mm), at 26.77mm and 26.5mm respectively.
- For Portsmouth Harbour, both the Spring 2023 and the Autumn 2023 surveys had average lengths above MCRS, at 27.5mm and 29.13mm respectively.
- For Langstone Harbour, both the Spring 2023 and the Autumn 2023 surveys had average lengths above MCRS, at 26.96mm and 26.55mm respectively.

4 Discussion of Results

4.1 CPUE

Between the Autumn 2022 and Spring 2023 surveys the only significant result was a statistically significant increase in CPUE for Common cockle at/above the Minimum Conservation Reference Size (MCRS) in Portsmouth Harbour (Figure 3). For all other comparisons no significant difference

was found, suggesting that the current fishing pressure is not having a significant effect on the populations of the three sampled Bivalve Management Areas (BMAs). Effort within the Solent bivalve fishery did decrease during the 22/23 fishing season in comparison to the 21/22 season (Figure 12), however a lack of consistent trends across all populations sampled prevent clear conclusions from being drawn, and indicate results could instead be a factor of population changes during the year and influence of environmental variables.

Comparison of survey results during the closed season, between Spring 2023 and Autumn 2023 are mixed, however there is only one incidence of the CPUE increasing (Southampton Water, Manila clam at/above MCRS) with the other significant results being a decline (Portsmouth Harbour, common cockle, below MCRS) and the majority showing no significant difference. This should be considered along with there being consistent results between different survey years for the same survey period and that there are no indications to date of a significant effect of the fishery on stock levels or a significant decline in catch levels either reported by fishers or seen through the catch data. However, this should be monitored through the closed period for 2024 to determine if a similar pattern is seen for a second year.

From analyses run on surveys undertaken in the Spring of available years, as representations of post-fishing season conditions, statistically significant decreases in CPUE were found for the Manila clam population at/above MCRS within Southampton Water in 2023 in comparison to 2020 (Figure 4), and the populations of Common Cockle below MCRS within Southampton Water and Portsmouth Harbour in 2023 in comparison to both 2020 and 2022 (Figure 5 & 6). Assigning potential causes to these trends is not attempted as the significant declines in CPUE are not consistent year-on -year. As the analyses comparing the Autumn 2022 and Spring 2023 results suggest that current fishing pressure is not having a significant influence on the population, there are likely to be other factors influencing the data patterns seen between Spring surveys. For all other comparisons no significant difference was found.

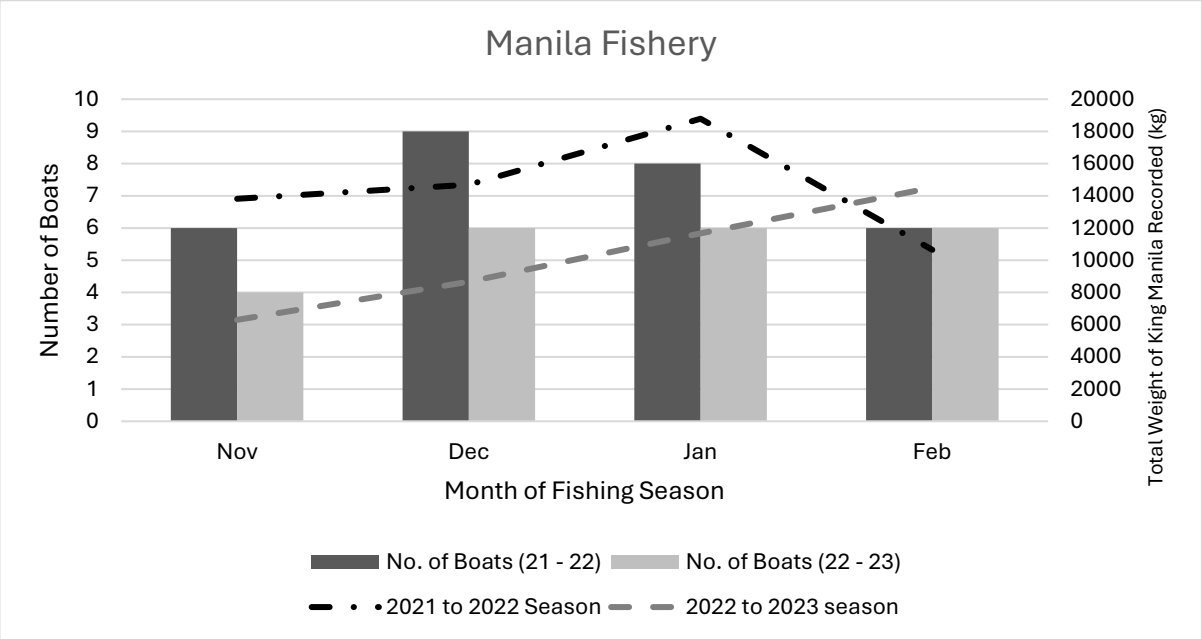

Figure 12: Solent Bivalve catch data 21/22 season compared to 22/23 season.

From analyses run on surveys undertaken in the Autumn of available years, as representations of pre-fishing season conditions, statistically significant decreases in CPUE were found for the population of Manila clam below MCRS in Southampton Water for 2021 and 2023 in comparison to 2019 (Figure 9), the Common cockle population below MCRS in Southampton Water from 2022 to 2021 (Figure 10), and the Common cockle population at/above MCRS in Portsmouth Harbour in 2023 in comparison to 2021 (Figure 11). These results reveal fluctuating patterns within the populations, but no general trend.

Following the close of the 2023/24 season in March 2024, only three years of catch data is available for the Solent Bivalve fishery, which was first collected in November 2021 when the Solent Dredge Permit Byelaw came into effect. As such there is not sufficient years of catch data to establish patterns or to relate catch data to patterns seen in the CPUE results. The lack of consistent trends within the BMA populations and the lack of significant results between Autumn 2022 and Spring 2023 survey results suggests that catch levels are not having a negative influence on the stock and that there are other factors which may be influencing changes/fluctuations in the stock levels between years.

4. 2 Average Length

Between the Autumn 2022 and Spring 2023 surveys, analyses found significant increases in average length for the Manila clam and Common cockle populations within Portsmouth Harbour (Figure 10 & 11). A significant decrease in average length during the fishing season was found within the Common cockle population in Langstone Harbour (Figure 12).

From analyses run on surveys undertaken in the Spring of available years, as representations of post-fishing season conditions, statistically significant results suggest the following trends:

- An increase in average length for the Manila clam population with Southampton Water from 2020 to 2023 (Figure 13);
- For the Manila clam population in Portsmouth Harbour, a decrease in average length from 2018 to 2020, then an increase from 2020 to 2023, with a higher average length in 2023 than in 2018 (Figure 14);
- A decrease in average length for the Manila clam population in Langstone Harbour from 2018 to 2023, with one period of increase between 2020 and 2022 (Figure 15);
- An increase in average length for the Common cockle population in Southampton Water up to 2022 (Figure 16);
- A general pattern of increase in average length for the Common cockle population in Portsmouth Harbour from 2018 to 2023, with year-on-year variation between 2018 and 2020 (Figure 17);
- A decrease in average length for the Comon cockle population in Langstone Harbour between 2019 and 2023 (Figure 18).

As the general pattern presented by these results is not consistent it is difficult to attribute any specific causes to them, and likely there are a number of influencing factors that caused the trends.

From analyses run on surveys undertaken in the Autumn of available years, as representations of pre-fishing season conditions, statistically significant results suggest the following trends:

- For the Manila clam and Common cockle populations within Southampton Water, an increase in average length from 2018 to 2021, then a decrease to 2023 (Figure 19 &22);

- A general pattern of increase in average length for the Common cockle population in Portsmouth Harbour, with inter-year variations centred on the 2022 survey (Figure 23);
- For the Common cockle population in Langstone Harbour, an increase in average length from 2018 to 2022 (Figure 24);
- Analysis of the Manila clam populations within Portsmouth and Langstone Harbours show levels of inter-year variation in average length too high to present a clear trend (Figure 20 & 21).

As the general pattern presented by these results is not consistent it is difficult to attribute any specific causes to them, and likely there are a number of influencing factors that caused the trends.

When looking at the occurrence of the bivalve species' average lengths during each survey between the three Bivalve Management Areas, clear picture appears. Throughout the survey timeseries, the average length of each survey has remained above the MCRS of 23.8mm for Common cockle within the three Bivalve Management Areas surveyed. This is also the case for Manila clam within Langstone Harbour. However, Manila clam within Southampton Water have consistently had a survey average length below that of MCRS (35mm), while Manila clam within Portsmouth Harbour have only had a survey average length above MCRS in 2018 and 2023. These trends will continue to be monitored during future surveys.

Summary

- In 2023, surveys were undertaken in April and September, collecting weight and length data on populations of Manila clam and Common Cockle with three Bivalve Management Areas, Southampton Water, Portsmouth Harbour, and Langstone Harbour.
- In analyses run between the pre-fishing season survey (Autumn 2022) and the post-fishing season survey (Spring 2023), CPUE for Manila clam and Common cockle at/above and below MCRS was found to have no significant difference for all Bivalve Management Areas except for the Common cockle population at/above MCRS within Portsmouth Harbour, where CPUE increased.
- In analyses run between the post-fishing season survey (Spring 2023) and the pre-fishing season survey (Autumn 2023), CPUE at/above MCRS for the Manila clam in Southampton Water was found to increase and CPUE below MCRS for common cockle in Portsmouth Harbour was seen to decrease, there were no other significant differences.
- For analysis run on Spring surveys, CPUE results from the 2023 survey were found to be significantly lower for the Manila clam population at/above MCRS in Southampton Water than in 2020, and the Common cockle population below MCRS in Southampton Water and in Portsmouth Harbour than in 2022 and 2020.
- For the analysis run on Autumn surveys, CPUE results from the 2023 survey were found to be significantly lower for the Manila clam population at/above MCRS in Southampton Water in comparison to 2019, and for the Common cockle population below MCRS in Portsmouth Harbour in comparison to 2021.
- In analysis run between the pre-fishing season survey (Autumn 2022) and the post-fishing season (Spring 2023), average length was found to significantly increase during the fishing season for the Manila clam and Common cockle population in Portsmouth Harbour, and to significantly decrease during the fishing season for the Common cockle population in Langstone Harbour.

- For all analyses run on CPUE and average length where significant results were found, no general trends were observed.
- Within the Solent Bivalve timeseries, all surveys to date have had average lengths below the MCRS for Manila clam populations in Southampton Water, and only 2018 and 2023 surveys have had average lengths above MCRS for Manila clam populations in Portsmouth Harbour. All surveys within the timeseries have had average lengths above MCRS for Manila clam populations within Langstone Harbour, and have had average Common cockle lengths above MCRS within all three Bivalve Management Areas.

Annex 1

Average Length Analysis

Comparison between pre and post fishing season

The average length of each species was compared between the Autumn 2022 survey as a representation of conditions pre-fishing season and the Spring 2023 survey as a representation of condition post-fishing season.

Manila Clam

- For Southampton Water, a Dunn's post-hoc analysis found no statistically significant difference between average length for the surveys in Autumn 2022 (33.1mm) and Spring 2023 (33.8mm).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found a statistically significant increase in average length between the Autumn 2022 (33.3mm) and Spring 2023 (36.4mm) surveys ($p < 0.01$) (Figure 10).
- For Langstone Harbour, a Dunn's post-hoc analysis found no statistically significant difference between average length for the surveys in Autumn 2022 (38.7mm) and Spring 2023 (37mm).
- For Southampton Water, both surveys had average lengths below MCRS. For Portsmouth Harbour, the autumn 2022 survey had an average length below MCRS while the spring survey 2023 had an average length above MCRS. For Langstone Harbour, both surveys had average lengths above MCRS.

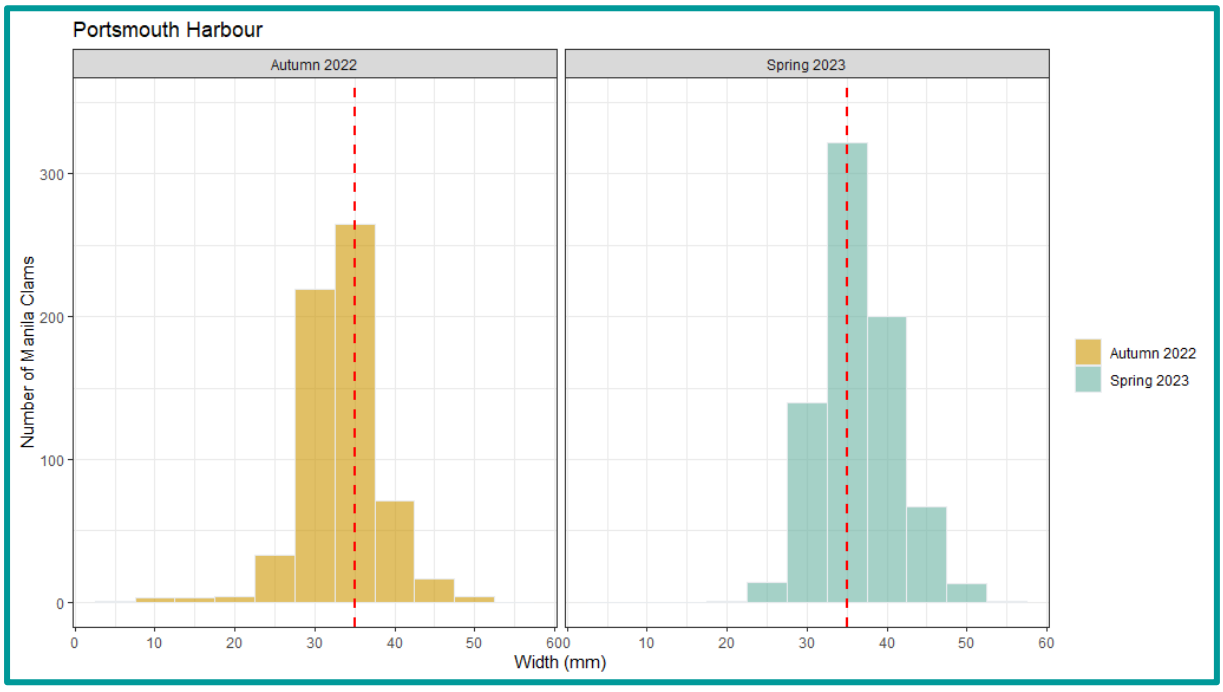

Figure 13: Comparison of average length of Manila Clam between the Autumn 2022 and Spring 2023 surveys for Portsmouth Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

Common Cockle

- For Southampton Water, a Dunn's post-hoc analysis found no statistically significant difference between average length for the surveys in Autumn 2022 (26.8mm) and Spring 2023 (26.8mm).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found a statistically significant increase in average length between the Autumn 2022 (25.5mm) and Spring 2023 (27.5mm) surveys ($p < 0.01$) (Figure 11).
- For Langstone Harbour, a Dunn's post-hoc analysis found a statistically significant decrease in average length between the Autumn 2022 (29.4mm) and Spring 2023 (27mm) surveys ($p < 0.01$) (Figure 12).
- For all cases the average length was above the MCRS of 23.8mm.

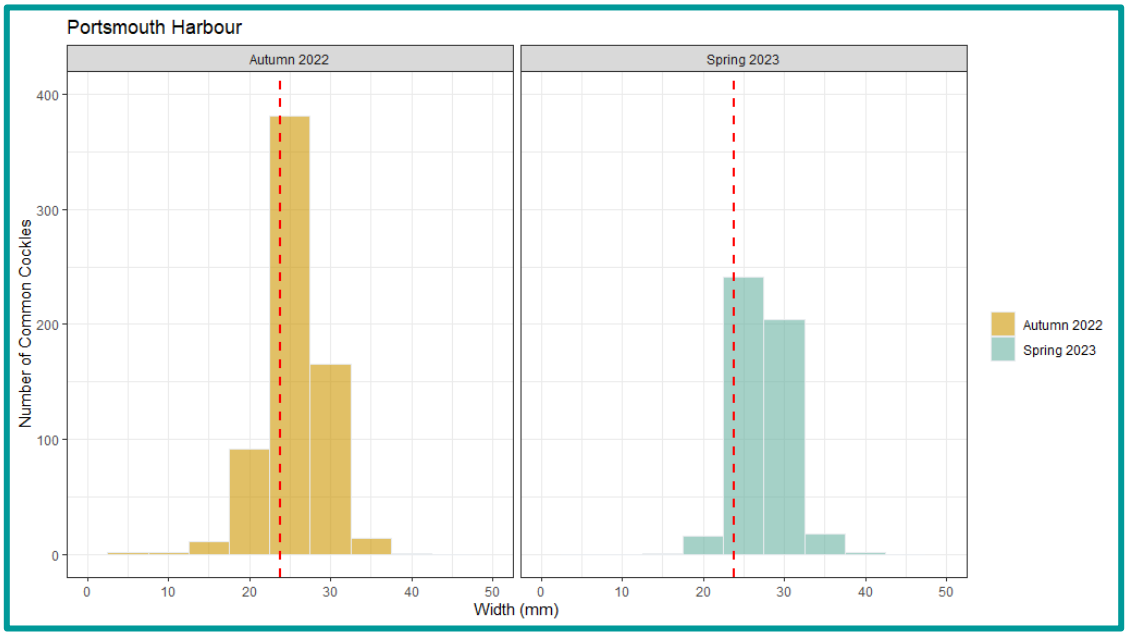

Figure 14: Comparison of average length of Common Cockles between the Autumn 2022 and Spring 2023 surveys for Portsmouth Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

3.2.2 Comparison between surveys run in 2023

A comparison between the Spring 2023 and Autumn 2023 surveys was carried out to analyse changes to population traits during the fishery closed season.

Dunn's post-hoc analyses for Manila Clam and Common Cockle found no statistically significant differences in CPUE at/above or below MCRS between the surveys run in 2023 for any of the BMAs.

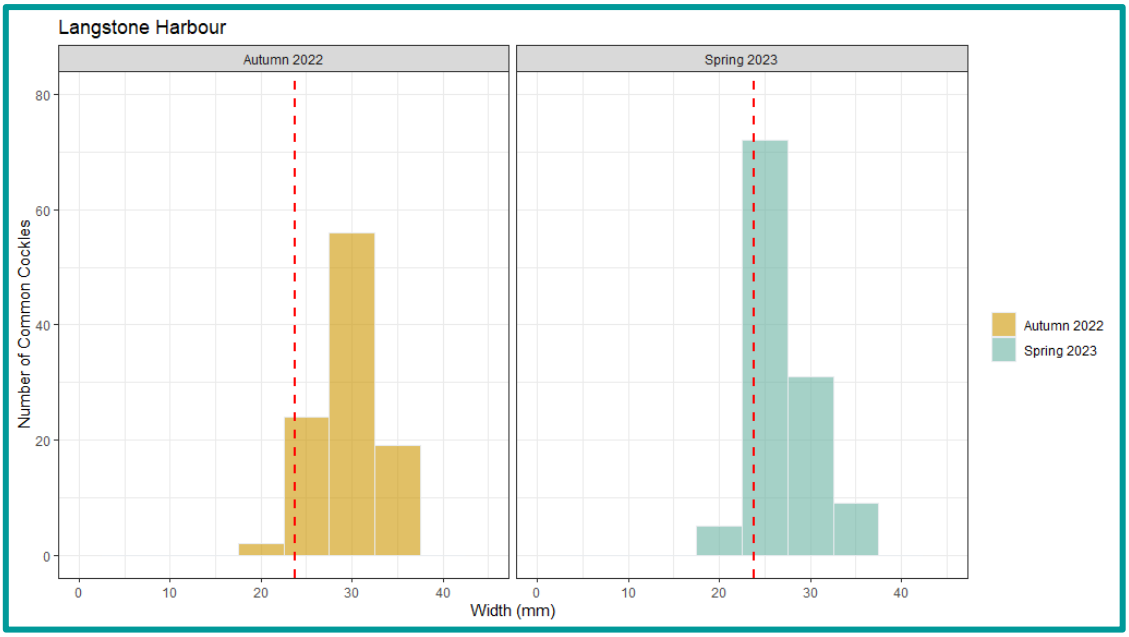

Figure 15: Comparison of average length of Common Cockles between the Autumn 2022 and Spring 2023 surveys for Langstone Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

3.2.3 Comparison between survey years for spring (post-fishing season) surveys

The average length of each species in each Management Area was analysed for each spring survey from 2018 to 2023 (there is no data for 2021 due to the Covid-19 pandemic).

Manila Clam

- For Southampton Water, a Dunn's post-hoc analysis found statistically significant increases in average length between the surveys in (Figure 16):
    - Spring 2020 (33.9mm) in comparison to Spring 2018 (33.2mm) and Spring 2019 (32.7mm) ($p < 0.01$);
    - Spring 2022 (34.3mm) in comparison to Spring 2018 (33.2mm), Spring 2019 (32.7mm), and Spring 2020 (33.9mm) ($p < 0.01$);
    - Spring 2023 (33.8mm) in comparison to Spring 2018 (33.2mm), Spring 2019 (32.7mm), and Spring 2020 (33.9mm) ($p < 0.01$).

- For Portsmouth Harbour, a Dunn's post-hoc analysis found statistically significant decreases in average length between the surveys in (Figure 17):
    - Spring 2019 (34.7mm) in comparison to Spring 2018 (35.9mm) ($p < 0.05$);
    - Spring 2020 (33.4mm) in comparison to Spring 2018 (35.9mm) and Spring 2019 (34.7mm) ($p < 0.01$);
- And statistically significant increases in average length between the surveys in (Figure 17):
    - Spring 2022 (34.9mm) in comparison to Spring 2020 (33.4mm) ($p < 0.01$);
    - Spring 2023 (36.4mm) in comparison to Spring 2019 (34.7mm), Spring 2020 (33.4mm), and Spring 2022 (34.9mm) ($p < 0.01$).

- For Langstone Harbour, a Dunn's post-hoc analysis found statistically significant decreases in average length between the surveys in (Figure 18):

- Spring 2019 (38.5mm) in comparison to Spring 2018 (40.7mm) ($p < 0.05$);
- Spring 2020 (37.8mm) in comparison to Spring 2018 (40.7mm) ($p < 0.01$);
- Spring 2023 (37mm) in comparison to Spring 2018(40.7mm) and Spring 2022 (39.4mm) ($p < 0.01$);

- And statistically significant increase in average length between the surveys in (Figure 18):
  - Spring 2022 (39.4mm) in comparison to Spring 2020 (37.8mm) ($p < 0.01$).

For Southampton Water, all surveys had average lengths below MCRS. For Portsmouth Harbour, the 2019, 2020, and 2022 surveys had average lengths below MCRS while the 2018 and 2023 surveys had an average length above MCRS. For Langstone Harbour, all surveys had average lengths above MCRS.

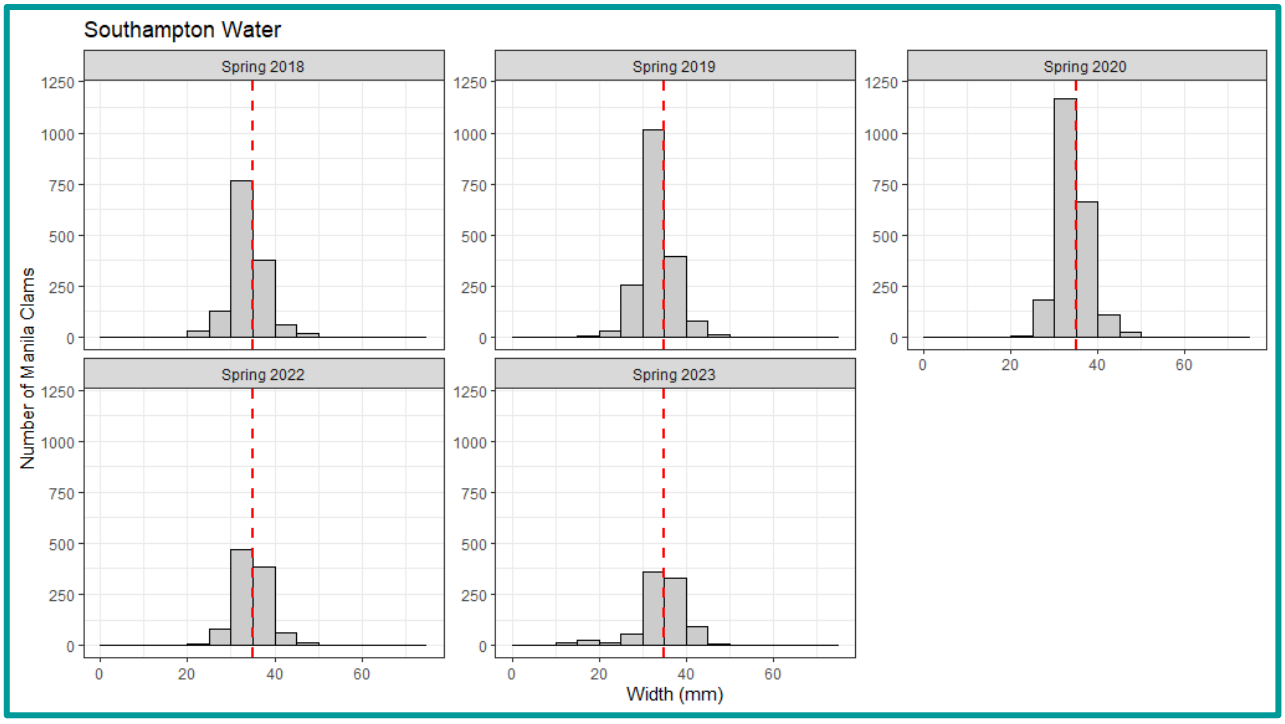

Figure 16: Comparison of average length of Manila Clam between the (available) Spring surveys in Southampton Water. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

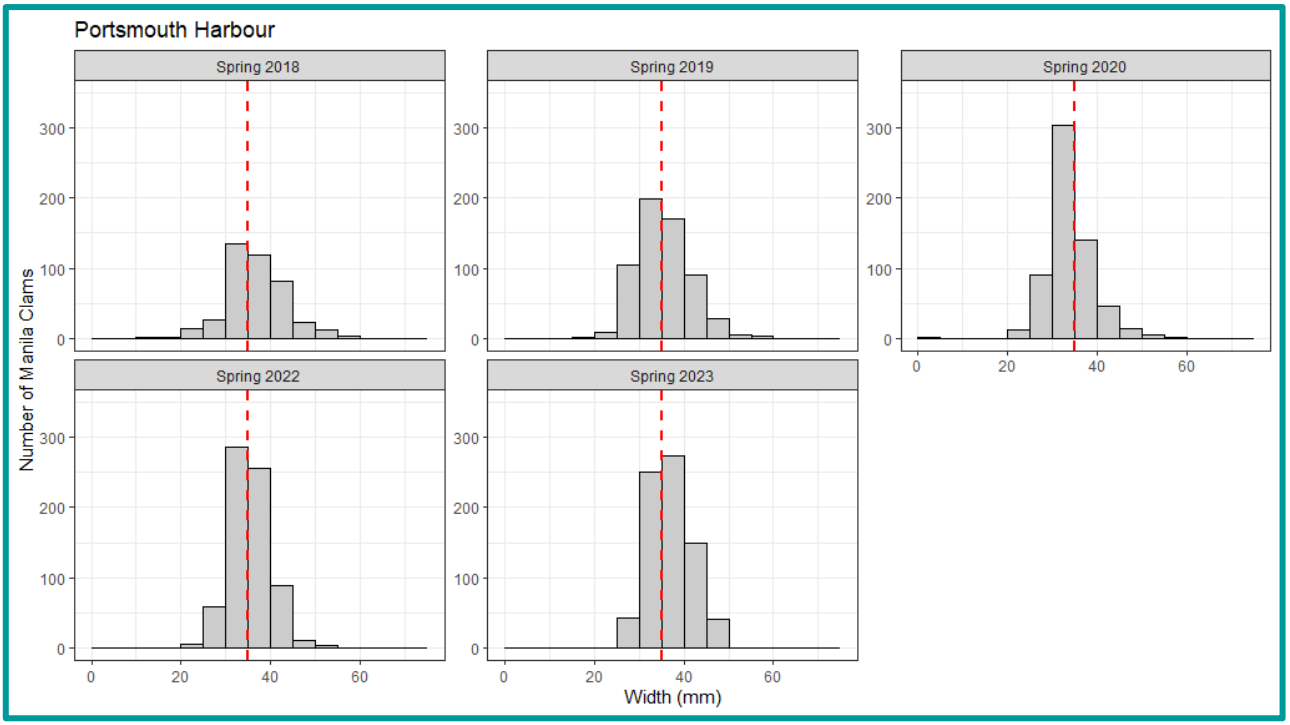

Figure 17: Comparison of average length of Manila Clam between the (available) Spring surveys in Portsmouth Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

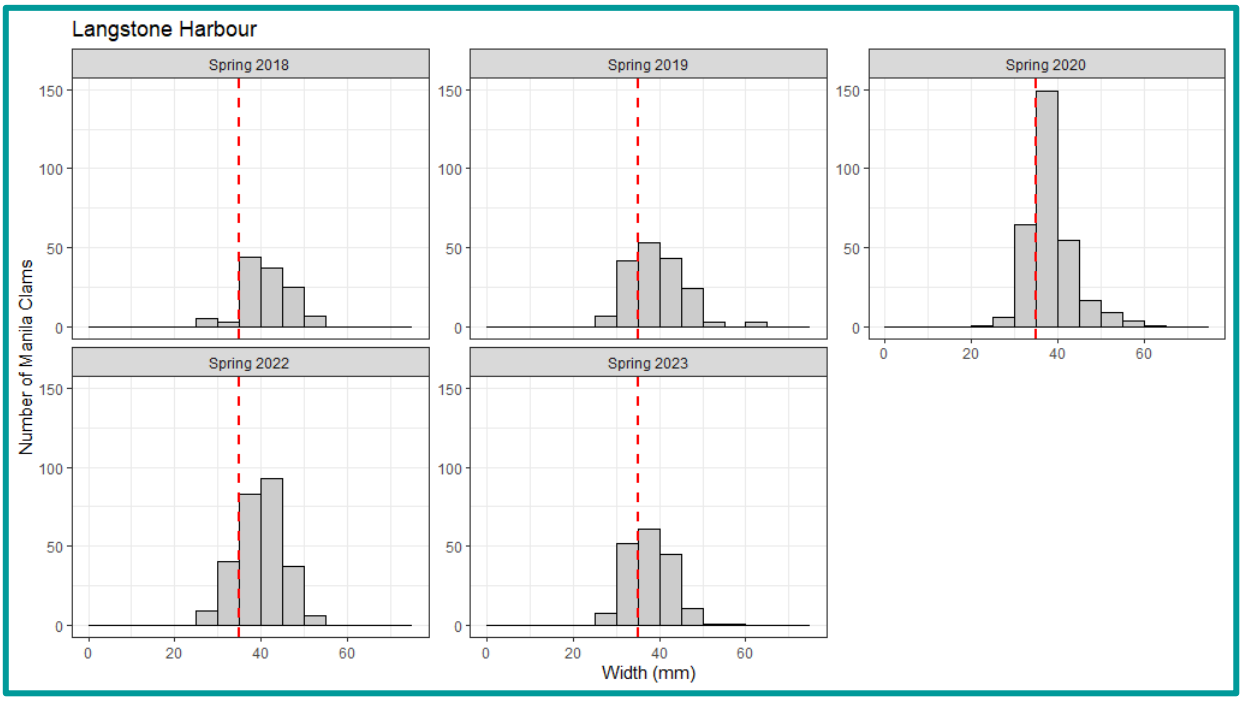

Figure 18: Comparison of average length of Manila Clam between the (available) Spring surveys in Langstone Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

Common Cockle

- For Southampton Water, a Dunn's post-hoc analysis found statistically significant increases in average length between the surveys in (Figure 19):
    - Spring 2020 (27.2mm) in comparison to Spring 2018 (26.5mm) ($p < 0.01$);
    - Spring 2022 (27.1mm) in comparison to Spring 2018 (26.5mm) and Spring 2019 (26.8mm) ($p < 0.01$).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found statistically significant increases in average length between the surveys in (Figure 20):
    - Spring 2019 (27.3mm) in comparison to Spring 2018 (26.3mm) ($p < 0.01$);
    - Spring 2022 (27mm) in comparison to Spring 2018 (26.3mm) and Spring 2020 (25.7mm) ($p < 0.01$);
    - Spring 2023 (27.5mm) in comparison to Spring 2018 (26.3mm) and Spring 2020 (25.7mm) ($p < 0.01$).
- And statistically significant decreases in average length between the surveys in (Figure 20):
    - Spring 2020 (25.7mm) in comparison to Spring 2018 (26.3mm) ($p < 0.05$) and Spring 2019 (27.3mm) ($p < 0.01$).
- For Langstone Harbour, a Dunn's post-hoc analysis found statistically significant decreases in average length between the surveys in (Figure 21):
    - Spring 2020 (27mm) in comparison to Spring 2018 (28mm) and Spring 2019 (28.4mm) ($p < 0.01$);
    - Spring 2022 (27.3mm) in comparison to Spring 2018 (28mm) and Spring 2019 (28.4mm) ($p < 0.01$);
    - Spring 2023 (27mm)) in comparison to Spring 2018 (28mm) and Spring 2019 (28.4mm ($p < 0.01$).

For all cases the average length was above the MCRS of 23.8mm.

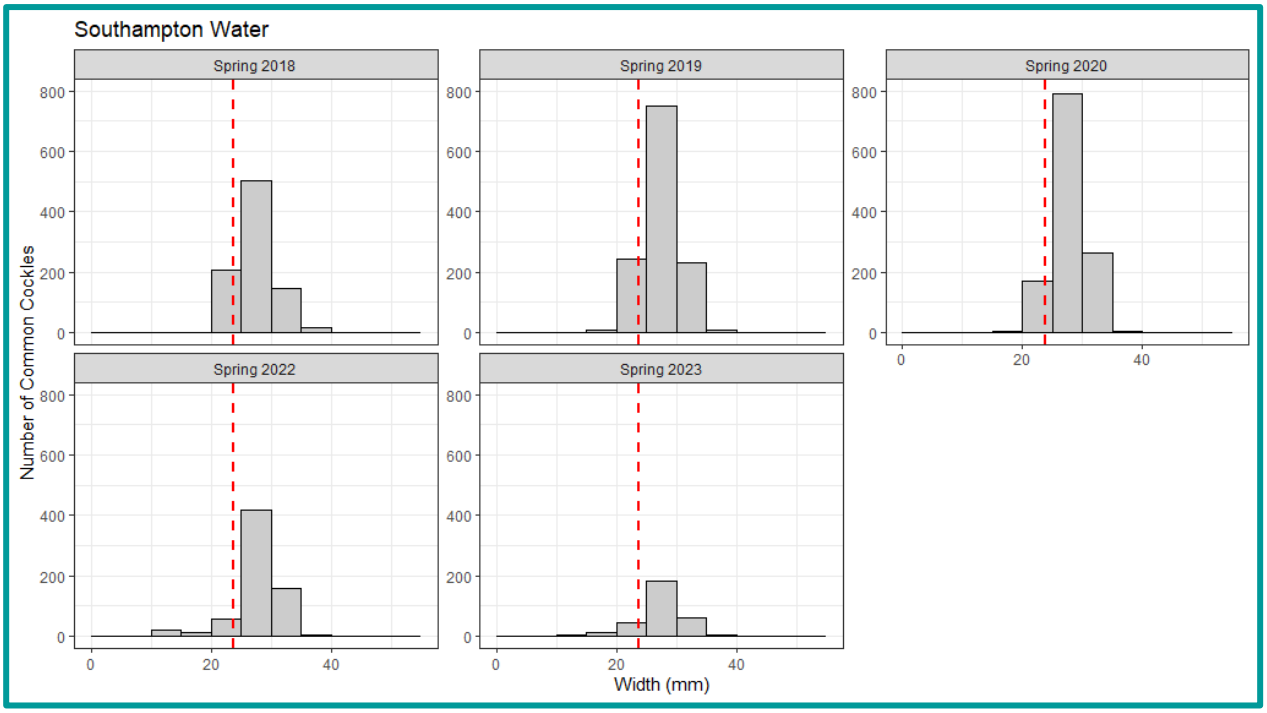

Figure 19: Comparison of average length of Common Cockle between the (available) Spring surveys in Southampton Water. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

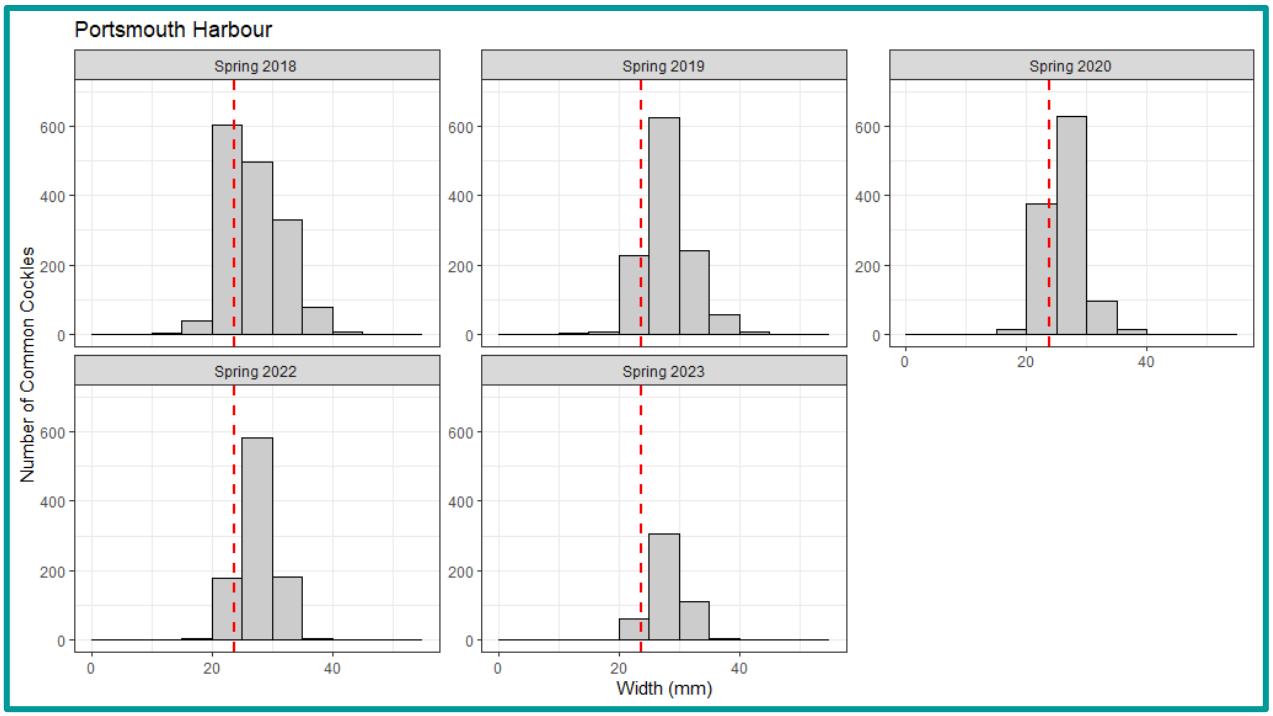

Figure 20: Comparison of average length of Common Cockle between the (available) Spring surveys in Portsmouth Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

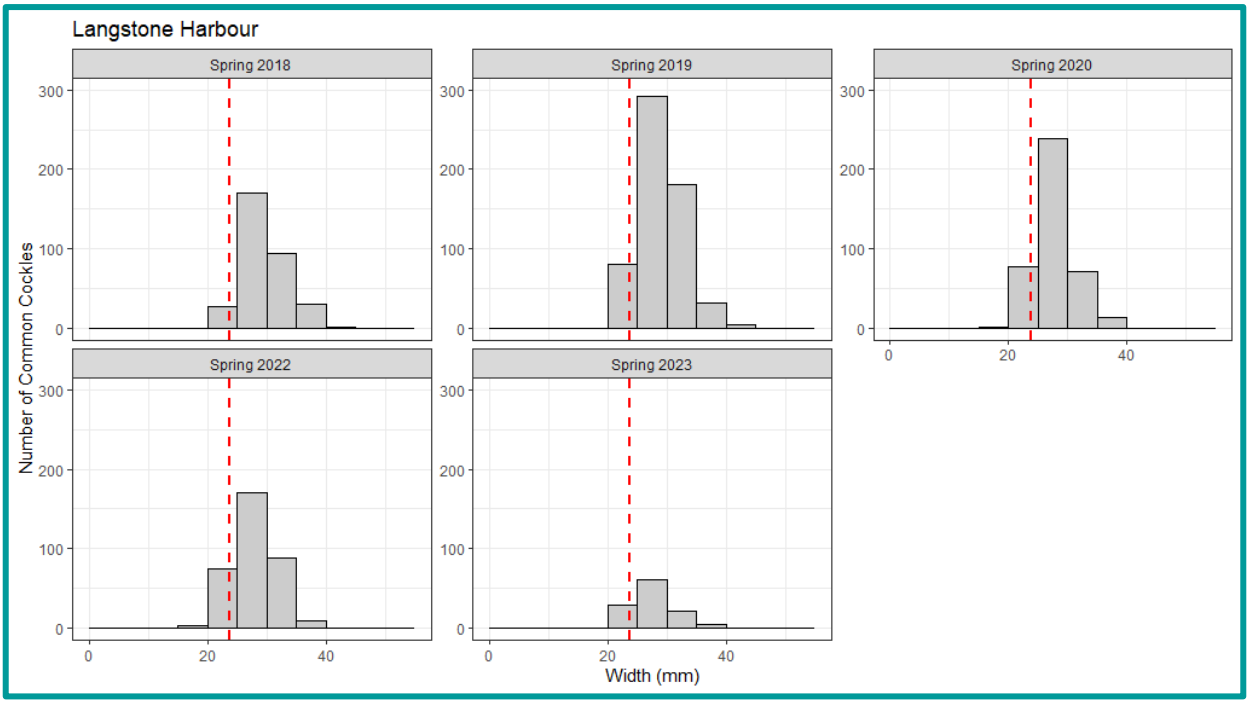

Figure 21: Comparison of average length of Common Cockle between the (available) Spring surveys in Langstone Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

3.2.3 Comparison between survey years for autumn (post fishing season) surveys

The average length of each species in each Management Area was analysed for each autumn survey from 2018 to 2023 (there is no data for 2020 due to the Covid-19 pandemic).

Manila Clam

- For Southampton Water, a Dunn's post-hoc analysis found statistically significant increases in average length between the surveys in (Figure 22):
    - Autumn 2021 (34.6mm) in comparison to Autumn 2019 (32.5mm) and Autumn 2018 (31.9mm) ($p < 0.01$);
    - Autumn 2022 (33.1mm) in comparison to Autumn 2019 (32.5mm), and Autumn 2018 (31.9mm) ($p < 0.01$);
    - Autumn 2023 (32.8mm) in comparison to Autumn 2019 (32.5mm) ($p < 0.05$) and Autumn 2018 (31.9mm) ($p < 0.01$);
- And statistically significant decreases in average length between the surveys in (Figure 22):
    - Autumn 2022 (33.1mm) and Autumn 2023 (32.8mm) in comparison to Autumn 2021 (34.6mm) ($p < 0.01$).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found statistically significant decreases in average length between the surveys in (Figure 23):
    - Autumn 2019 (33.4mm) in comparison to Autumn 2018 (35.7mm) ($p < 0.01$);
    - Autumn 2022 (33.3mm) in comparison to Autunm 2021 (34.8mm) and Autumn 2018 (35.7mm) ($p < 0.01$);
- And significant increases in average length between the surveys in (Figure 23):
    - Autumn 2021 (34.8mm) in comparison to Autumn 2019 (33.4mm) ($p < 0.01$);

  - Autumn 2023 (35.8mm) in comparison to Autumn 2022 (33.3mm) and Autumn 2019 (33.4mm) ($p < 0.01$).
- For Langstone Harbour, a Dunn's post-hoc analysis found a statistically significant decrease in average length between the surveys in (Figure 24):
  - Autumn 2021 (36.3mm) in comparison to Autumn 2018 (39.4mm) ($p < 0.01$).
- And statistically significant increases in average length between the surveys in (Figure 24):
  - Autumn 2021 (36.3mm) in comparison to Autumn 2019 (39.3mm) ($p < 0.01$);
  - Autumn 2022 (38.7mm) in comparison to Autumn 2021 (36.3mm) ($p < 0.01$).

For Southampton Water, all surveys had average lengths below MCRS. For Portsmouth Harbour, the 2019, 2021, and 2022 surveys had average lengths below MCRS while the 2018 and 2023 surveys had an average length above MCRS. For Langstone Harbour, all surveys had average lengths above MCRS.

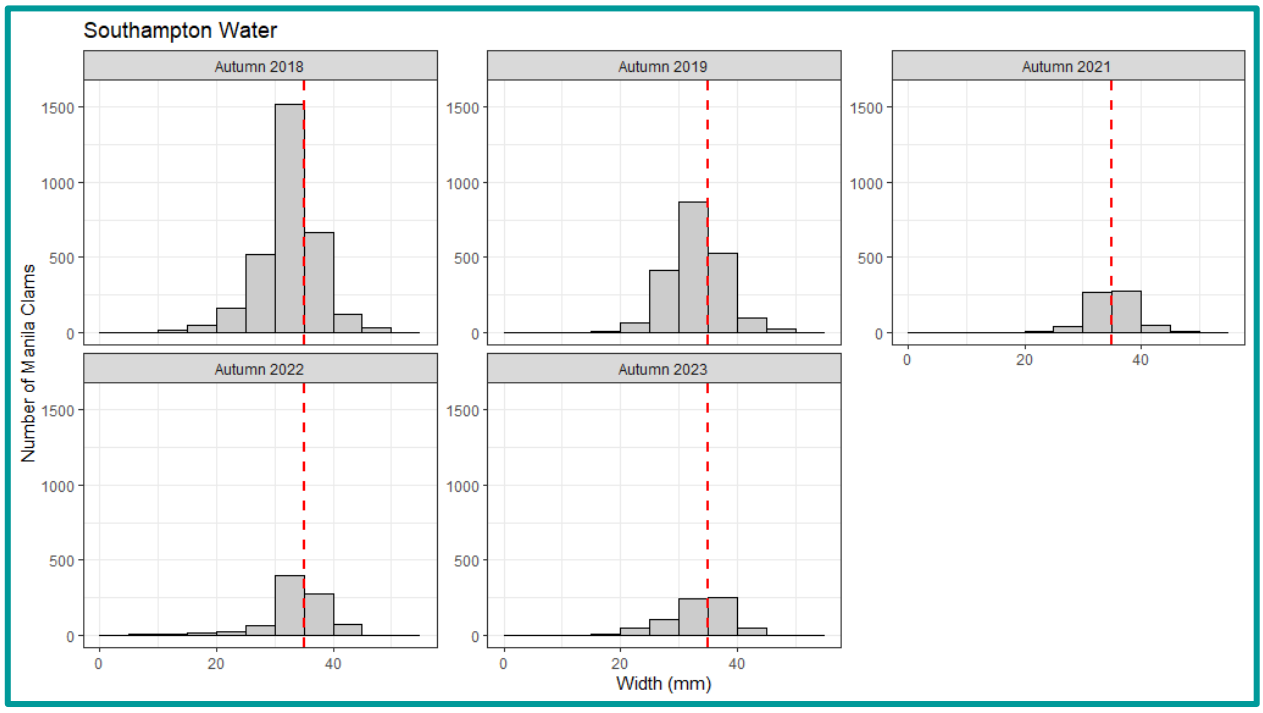

Figure 22: Comparison of average length of Manila Clam between the (available) Autumn surveys in Southampton Water. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

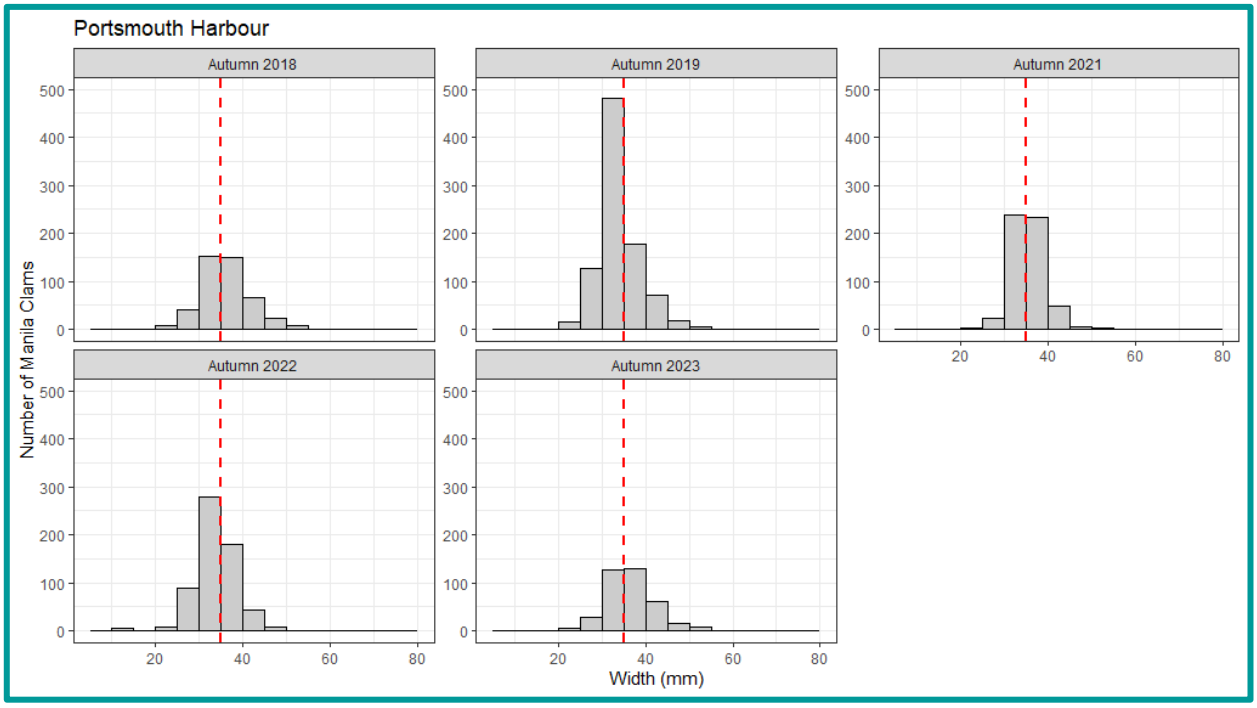

Figure 23: Comparison of average length of Manila Clam between the (available) Autumn surveys in Portsmouth Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

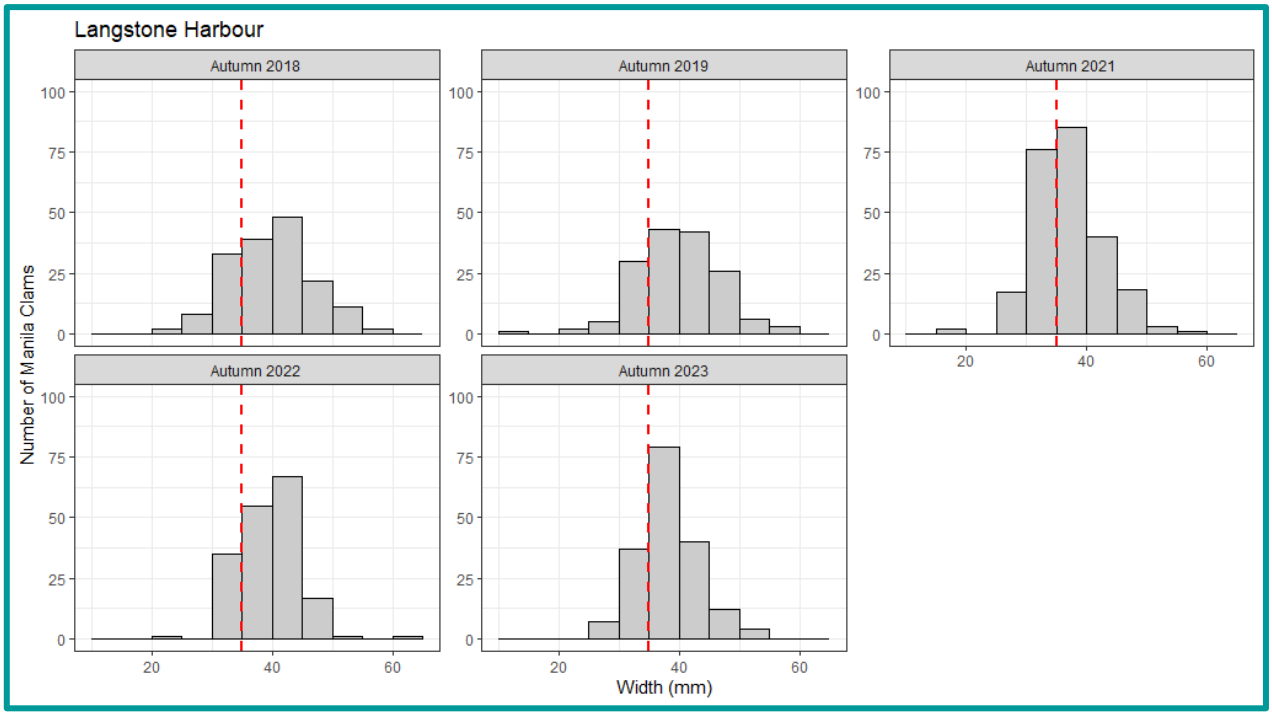

Figure 24: Comparison of average length of Manila Clam between the (available) Autumn surveys in Langstone Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (35mm).

Common Cockle

- For Southampton Water, a Dunn's post-hoc analysis found statistically significant increases in average length between the surveys in (Figure 25):
    - Autumn 2021 (29.1mm) in comparison to Autumn 2018 (26.5mm) and Autumn 2019 (26.4mm) ($p < 0.01$);
    - Autumn 2022 (26.8mm) in comparison to Autumn 2018 (26.5mm) ($p < 0.01$);
- And statistically significant decreases in average length between the surveys in (Figure 25):
    - Autumn 2022 (26.8mm) in comparison to Autumn 2021 (29.1mm) ($p < 0.01$);
    - Autumn 2023 (26.5mm) in comparison to Autumn 2021 (29.1mm) ($p < 0.01$).
- For Portsmouth Harbour, a Dunn's post-hoc analysis found statistically significant decrease in average length between the surveys in (Figure 26):
    - Autumn 2019 (26.8mm) in comparison to Autumn 2018 (27.6mm) ($p < 0.01$);
    - Autumn 2022 (25.5mm) in comparison to Autumn 2018 (27.6mm), Autumn 2019 (26.8mm), and Autumn 2021(28.1mm) ($p < 0.01$).
- And statistically significant increases in average length between the surveys in (Figure 26):
    - Autumn 2021(28.1mm) in comparison to Autumn 2018 (27.6mm) and Autumn 2019 (26.8mm) ($p < 0.01$)
    - Autumn 2023 (29.1mm) in comparison to Autumn 2018 (27.6mm), Autumn 2019 (26.8mm), and Autumn 2022 (25.5mm) ($p < 0.01$).
- For Langstone Harbour, a Dunn's post-hoc analysis found statistically significant decreases in average length between the surveys in (Figure 27):
    - Autumn 2019 (27.1mm) in comparison to Autumn 2018 (28.3mm) ($p < 0.05$);
    - Autumn 2023 (26.6mm) in comparison to Autumn 2018 (28.3mm) ($p < 0.05$) and Autumn 2022 (29.4mm) ($p < 0.01$).
- And statistically significant increases in average length between the surveys in (Figure 27):
    - Autumn 2022 (29.4mm) in comparison to Autumn 2019 (27.1mm) ($p < 0.01$) and Autumn 2021 (28mm) ($p < 0.05$).

For all cases the average length was above the MCRS of 23.8mm.

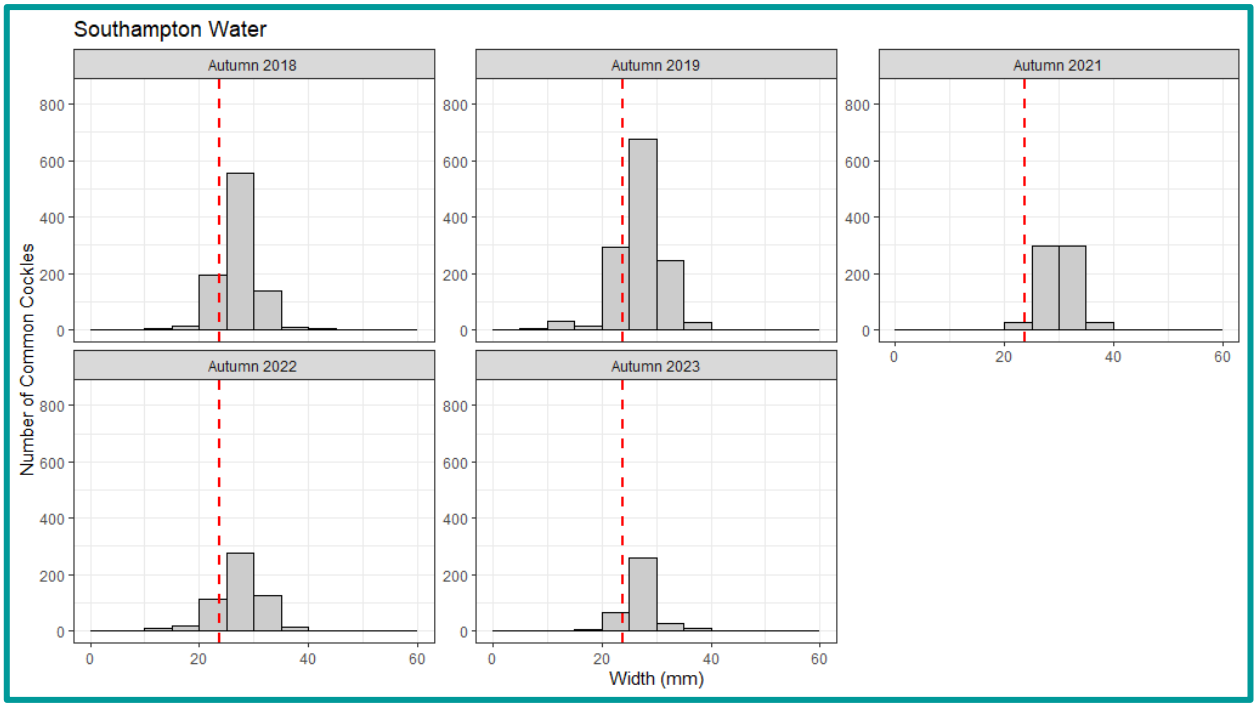

Figure 25: Comparison of average length of Common Cockle between the (available) Autumn surveys in Southampton Water. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

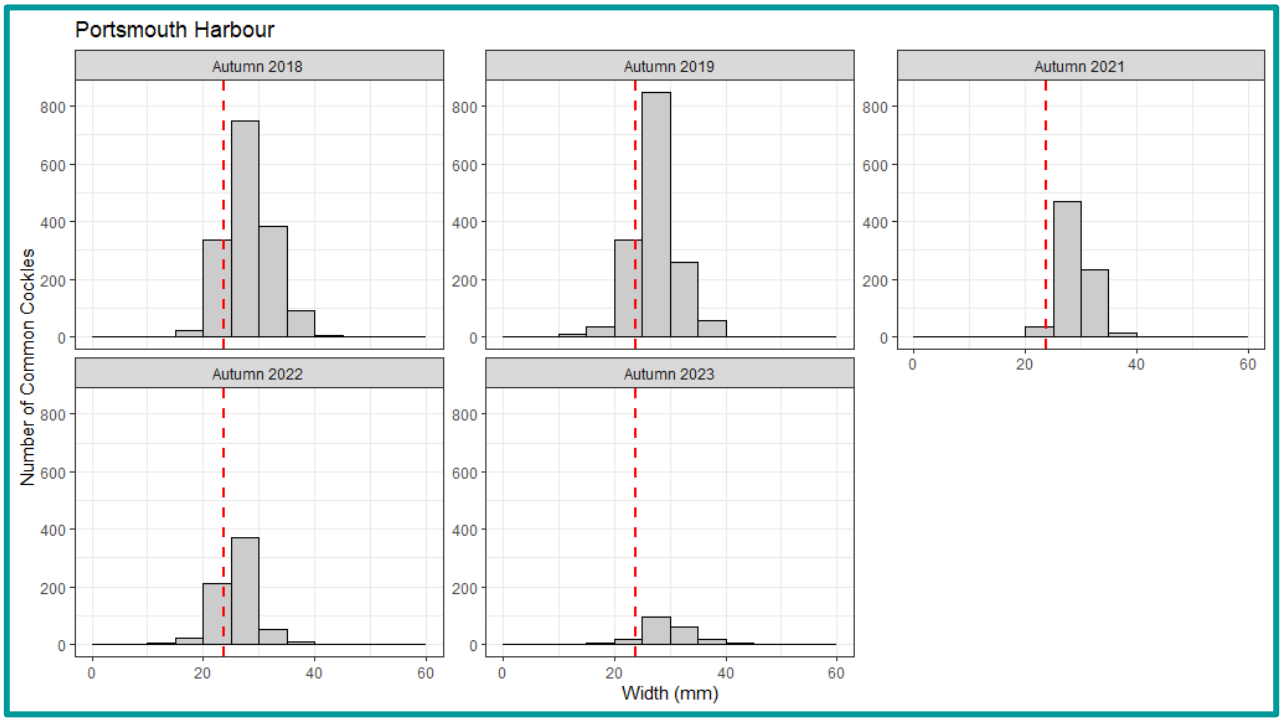

Figure 26: Comparison of average length of Common Cockle between the (available) Autumn surveys in Portsmouth Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).

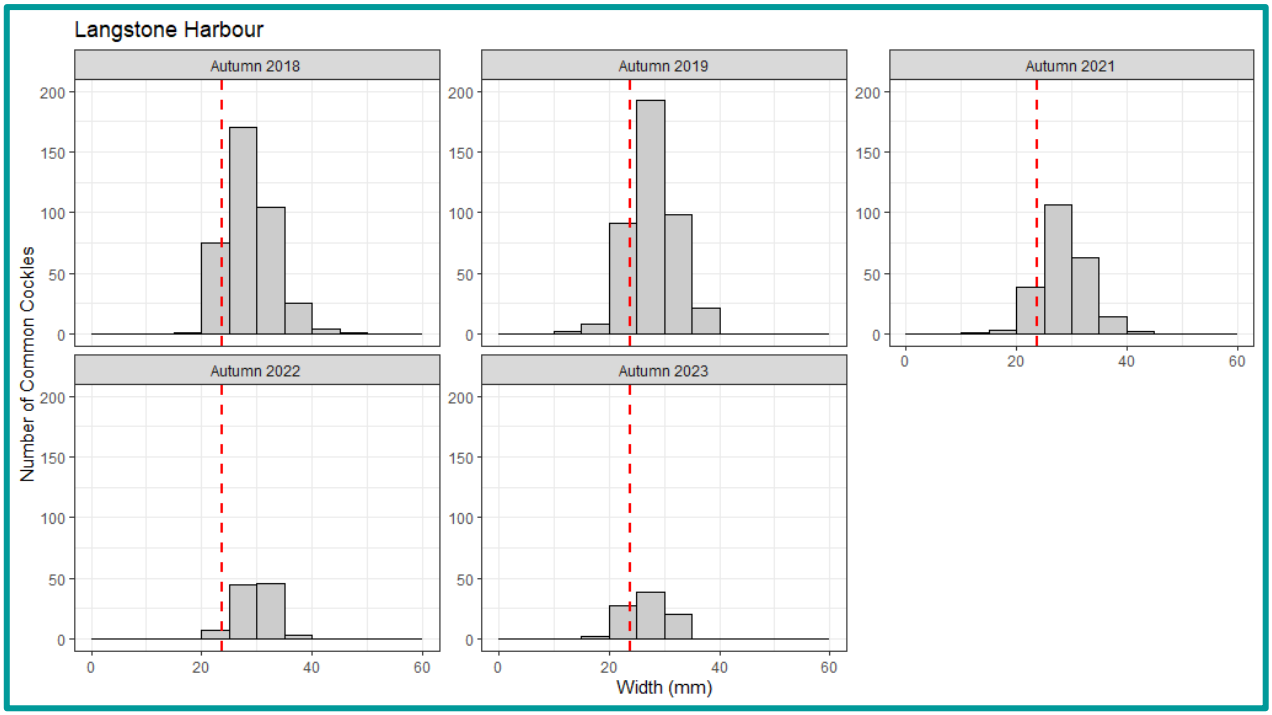

Figure 27: Comparison of average length of Common Cockle between the (available) Autumn surveys in Langstone Harbour. The red reference line is provided to show the Minimum Conservation Reference Size (23.8mm).