Southern IFCA Survey Report

Solent Scallop Survey, 2022

1. Introduction

As part of Southern IFCA's management of bivalve species in the Solent, surveys have been carried out to better understand the extent and nature of the Solent King scallop fishery.

This survey aims to provide an understanding of the distribution of the King scallop (*Pecten maximus*) and collect information on the population structure of the scallops found within the Solent.

The intention is to use the findings of this survey as part of a developing biannual monitoring programme which will enable Southern IFCA to monitor population trends before and after the fishing season (1st October to 31st March). This will feed directly into informing management through the Solent Dredge Permit Byelaw, enabling the Southern IFCA to ensure that the Solent bivalve fisheries are managed in a sustainable way.

2. Methodology

- 19 pre-defined sites were surveyed across 3 days in October 2022 (Autumn 2022) and April 2022 (Spring 2022), before and after the fishing season respectively.
- Areas for the survey were defined in 2021 in consultation with local fishers. The first survey was carried out in July 2021 (Summer 2021).
- Two chartered local fishing vessels are used to carry out the survey using a single N-Viro style dredge (Figure 1) towed from the stern of the vessel.

Figure 1: N-Viro Dredge

- At each site, three, 4-minute tows were performed, with the skipper identifying the appropriate direction and speed of the tows.
- The contents of the dredge were brought inboard, emptied, and sorted with scallops put aside for measuring.
- Officers then measured each scallop to the nearest mm in two dimensions, the length (longest axis) and the width (from the hinge to the outer shell edge).
- The catch for each tow was split into over 110mm (the minimum size in ICES VIId) and under 110mm. Both groups of scallops were then weighed.
- On completion of the measurements the scallops were returned to the same area from which they were sampled.

3. Results

In Autumn 2022, 19 Sites were surveyed, completing 57 tows, and a total of 3512 scallops were measured compared to 1153 scallops in Spring 2022.

Two chartered fishing vessels were used to carry out the survey across the 19 sites, each using their own scallop dredge equipment. In order to ensure that results from both fishing vessels are comparable, dredging was carried out in Spring 2022 by both vessels over the same shellfish bed (Osbourne 2). A non-parametric Kruskal-Wallis (KW) test was performed on the data collected by both vessels, the results of which indicated that there was not a statistically significant difference between the catch from the different dredges on each of the vessels ($H(1) = 0.032$, $p = 0.86$). The data set for all 19 sites has therefore been combined for the purposes of further analysis.

3.1. Catch Per Unit Effort (CPUE)

The data collected was analysed to provide a value for Catch Per Unit Effort (CPUE), defined as kg of scallops per metre of dredge per hour (kg/m/hr). CPUE was calculated for total kg of scallops, kg of scallops over the MCRS and kg of scallops under the MCRS (MCRS = 110mm). The caveat of CPUE under MCRS is the dredging method used to obtain data for this survey is inherently size selective due to the need to maximise retention of scallops >MCRS and minimize catches (and thus secondary sorting requirements) of scallops <MCRS.

On this basis the data for CPUE under MCRS will not be representative of this size class as it cannot be guaranteed that all scallops under MCRS have been sampled. However, comparisons can be made between sites and over time to look for changes, in the knowledge that the sampling method is consistent and there is no statistical difference in the catch between the two dredges used.

3.1.1. Spring 2022 (Figure 2)

Total CPUE

- The site with the greatest average total CPUE was Stanswood (Figure 2) at 102kg/m/hr whereas Stokes Bay had the lowest average total CPUE at 4kg/m/hr.
- A KW test found that there was a statistically significant difference between sites ($H(15) = 29.14$, $p < 0.05$).
- Post-hoc analysis in the form of a Tukey test showed that this difference only occurred between one pair of sites, with Stanswood having a significantly higher average total CPUE than Stokes Bay ($P<0.05$).

CPUE Over MCRS

- The site with the greatest average CPUE over MCRS was Stanswood at 89kg/m/hr whereas Stokes Bay had the lowest CPUE with 0kg/m/hr. Osbourne 3 had an Over MCRS CPUE of 74kg/m/hr.
- A KW test was found that there was a statistically significant difference between sites ($H(15) = 35.14$, $p<0.05$).
- Post-hoc analysis in the form of a Tukey test showed that Stanswood had a significantly higher average CPUE over MCRS than Stokes Bay ($P<0.05$) and Osbourne 3 had a significantly higher average CPUE over MCRS (at 74 kg/m/hr) than Stokes Bay ($P<0.05$).

Under MCRS CPUE

- The site with the greatest average CPUE under MCRS was Osbourne 2 at 53kg/m/hr whereas Stokes Bay had the lowest CPUE under MCRS at 4kg/m/hr.
- A KW test found that there was a statistically significant difference between sites (H (15) = 26.57, p<0.05).
- Post-hoc analysis in the form of a Tukey test showed no significant results indicating that the variance in the data within sites is greater than the variance between sites.

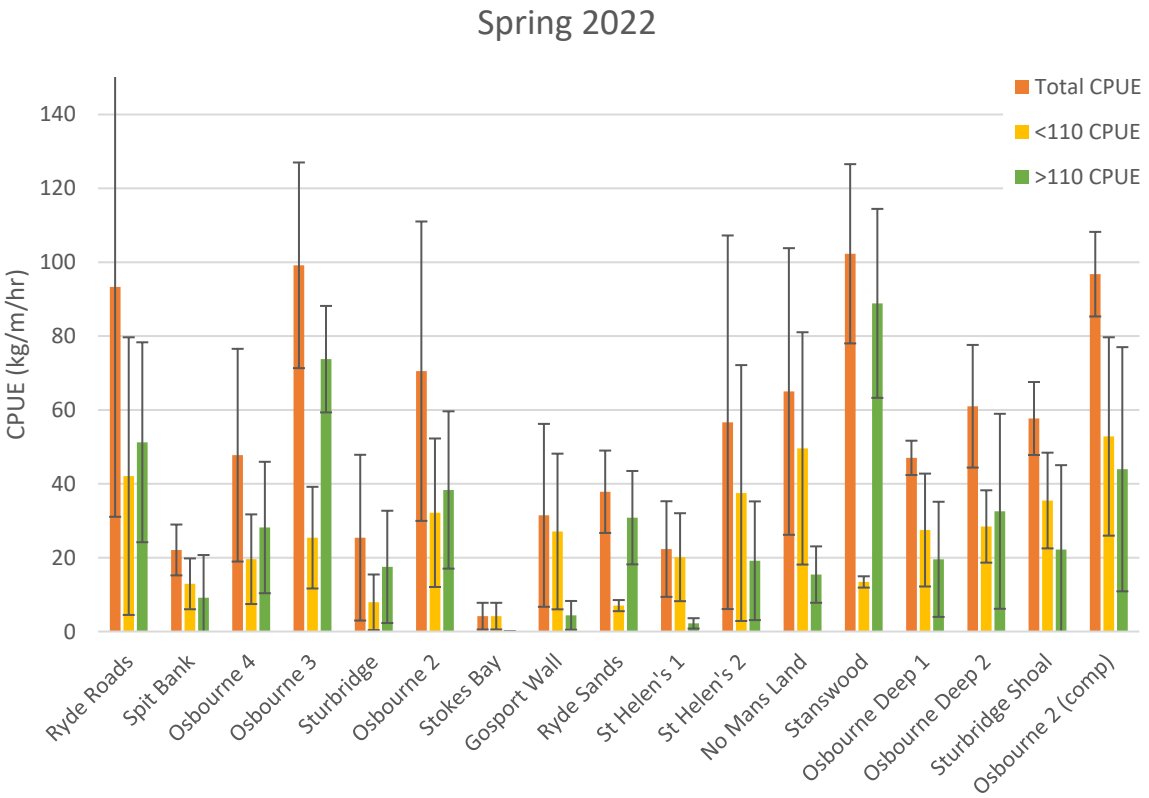

Figure 2: Catch per Unit Effort (CPUE, kg/m/hr) averaged over the three dredges for each site surveyed in Spring 2022. Total CPUE (Orange) is the combined average CPUE of scallops over and under the MCRS (110mm); CPUE <110 (Yellow) is the average CPUE below the MCRS; CPUE >110 (Green) is the average CPUE over the MCRS. Error bars show standard deviation from the mean of the 3 dredges.

3.1.2. Autumn 2022 (Figure 3)

Total CPUE

- The site with the greatest average total CPUE was Ryde Sands at 302kg/m/hr whereas Stanswood had the lowest average total CPUE at 25kg/m/hr.
- A KW test found that there was a statistically significant difference between sites (H (18) = 33.70, p<0.05).
- Post-hoc analysis in the form of a Tukey test showed no significant results indicating that the variance in the data within sites is greater than the variance between sites.

CPUE Over MCRS

- The site with the greatest CPUE over MCRS was Osbourne 2 at 106kg/m/hr whereas Ryde Middle had the lowest average CPUE over MCRS at 17kg/m/hr.
- A KW test found that there was not a statistically significant difference between sites (H (18) = 28.06, p = 0.061).

Under MCRS CPUE

- The site with the greatest average CPUE under MCRS was Ryde Sands at 220kg/m/hr whereas Stanswood had the lowest total CPUE at 3kg/m/hr.
- A KW test found that there was a statistically significant difference between sites ($H(18) = 39.57$, $p<0.05$).
- Post-hoc analysis in the form of a Tukey test showed that this difference only occurred between one pair of sites, with Ryde Sands having a significantly higher average CPUE under MCRS than Stanswood ($P<0.05$).

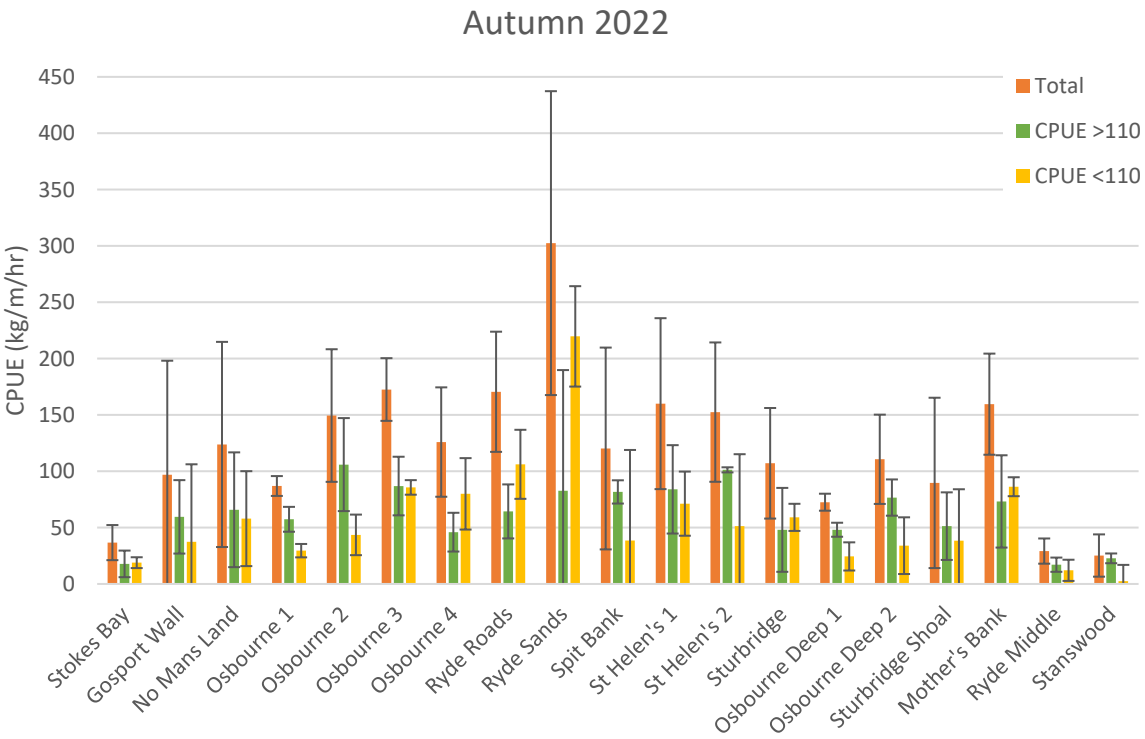

Figure 3: The Catch per Unit Effort (CPUE, kg/m/hr) averaged over the three dredges for each site surveyed in Autumn 2022. Total CPUE (Orange) is the combined average CPUE of scallops over and under the MCRS (110mm); CPUE <110 (Yellow) is the average CPUE below the MCRS; CPUE >110 (Green) is the average CPUE over the MCRS. Error bars show standard deviation from the mean of the 3 dredges.

3.1.3. Summer 2021 (Figure 4)

For the Summer 2021 survey, descriptive analysis of the data has been reproduced here from the 'Solent Scallop Survey Summary - July 2021'[1]. Note that fewer sites were surveyed in Summer 2021 compared to Spring 2022 and Autumn 2022.

- The site with the greatest average total CPUE was Osbourne 3 at 116kg/m/hr whereas Spit Bank had the smallest average total CPUE at 35.5kg/m/hr.
- Additionally, Osbourne 2 had the greatest average CPUE under MCRS at 68kg/m/hr, comparatively Osbourne 1 had the lowest average CPUE under MCRS at 20kg/m/hr (Figure 4).
- Osbourne 3 had the greatest average CPUE over MCRS at 69kg/m/hr comparatively Spit Bank had the smallest average CPUE over MCRS at 5.5kg/m/hr (Figure 4).

[1] https://www.southern-ifca.gov.uk/solent-dredge-permit

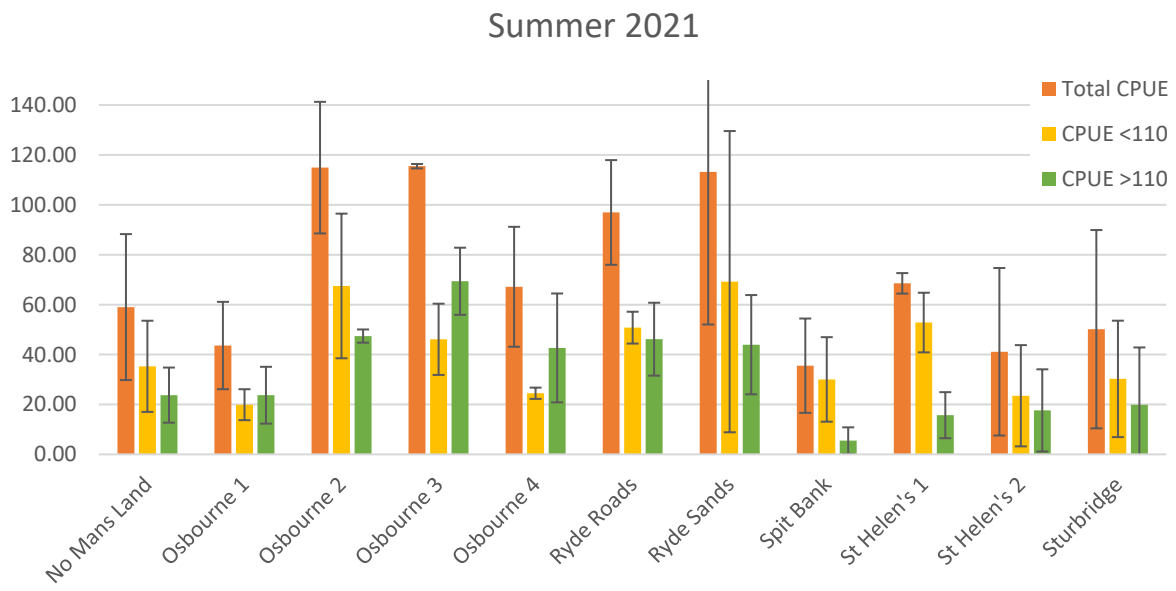

Figure 4: The Catch per Unit Effort (CPUE, kg/m/hr) averaged over the three dredges for each site surveyed in Summer 2021. Total CPUE (Orange) is the combined average CPUE of scallops over and under the MCRS (110mm); CPUE <110 (Yellow) is the average CPUE below the MCRS; CPUE >110 (Green) is the average CPUE over the MCRS. Error bars show standard deviation from the mean of the 3 dredges.

3.2. Comparing CPUE between surveys

Combining data for all sites for each survey, comparisons were made between Total CPUE, CPUE over MCRS and CPUE under MCRS between the three survey periods (Summer 2021, Spring 2022 and Autumn 2022).

3.2.1. Total CPUE

- A KW test showed that there was a statistically significant difference in total CPUE between surveys ($H(2) = 25.06$, $p<0.001$). Post-hoc analysis using Dunn's method (Table 1) showed:
    - The average total CPUE was significantly higher for the Autumn 2022 survey compared to the Spring 2022 survey ($p<0.001$) and compared to the Summer 2021 survey ($p<0.05$)
- There was not a statistically significant difference between the Summer 2021 survey and the Spring 2022 survey ($p=0.204$).

3.2.2. CPUE Over MCRS

- A KW test showed that there was a statistically significant difference in CPUE over MCRS between surveys ($H(2) = 18.75$, $p<0.001$). Post-hoc analysis using Dunn's method (Table 1) showed:
    - The average CPUE over MCRS was significantly higher for the Autumn 2022 survey compared to the Spring 2022 survey ($p<0.001$) and the CPUE over MCRS was significantly higher for the Summer 2021 survey compared to the Spring 2022 survey ($p<0.011$).
- There was not a statistically significant difference between Autumn 2022 and Summer 2021 ($p=1.00$).

3.2.3. CPUE Under MCRS

- A KW test showed that there was a statistically significant difference in CPUE under MCRS

between surveys (H (2) = 27.47, p<0.001). Post-hoc analysis using Dunn's method (Table 1) showed:

  - The average CPUE under MCRS was significantly higher for the Autumn 2022 survey compared to the Spring 2022 survey (p<0.001) and compared to the Summer 2021 survey (p<0.011).

- There was not a statistically significant difference between Summer 2021 and Spring 2022 (p=1.00).

3.2.4. Comparing CPUE for each site between surveys (Figures 5 & 6)

Comparisons were also made between the three surveys for each of the sampling sites, comparing Total CPUE, CPUE over MCRS and CPUE under MCRS. Not all sites were surveyed in all years so comparisons were made where a site had been surveyed in 2 or more survey periods. Only three sites showed significant results, outlined below, the remaining sites showed no significance between surveys for Total CPUE, CPUE over MCRS or CPUE under MCRS. A KW test was used in all cases. Data for the Spring 2022 and Autumn 2022 surveys, which are the most comparable in terms of sites surveyed, is shown in Figure 5.

- **Osbourne 3:** There was a statistically significant difference in the CPUE under MCRS between surveys (H (2) = 6.49, p<0.05). Post-hoc analysis using Dunn's method showed that the CPUE under MCRS was significantly higher in Autumn 2022 (173 kg/m/hr) compared to Spring 2022 (99 kg/m/hr) (p<0.05).
- **Ryde Sands:** There was a statistically significant difference in the Total CPUE and CPUE under MCRS between surveys (Total: H (2) = 6.49, p<0.05, Under MCRS: H (2) = 6.49, p<0.05). Post-hoc analysis using Tukey test showed that both Total CPUE and CPUE under MCRS were significantly higher in Autumn 2022 (Total = 302 kg/m/hr, Under MCRS = 220 kg/m/hr) compared to Spring 2022 (Total = 38 kg/m/hr, Under MCRS = 7 kg/m/hr) (p<0.05).
- **St Helen's 1:** There was a statistically significant difference in the Total CPUE and CPUE over MCRS between surveys (Total: H (2) = 7.2, p<0.001, Under MCRS: H (2) = 7.2, p<0.001). Post-hoc analysis using Tukey test showed that both Total CPUE and CPUE over MCRS were significantly higher in Autumn 2022 (Total = 160 kg/m/hr, Under MCRS = 71 kg/m/hr) compared to Spring 2022 (Total = 22 kg/m/hr, Under MCRS = 20 kg/m/hr) (p<0.05).

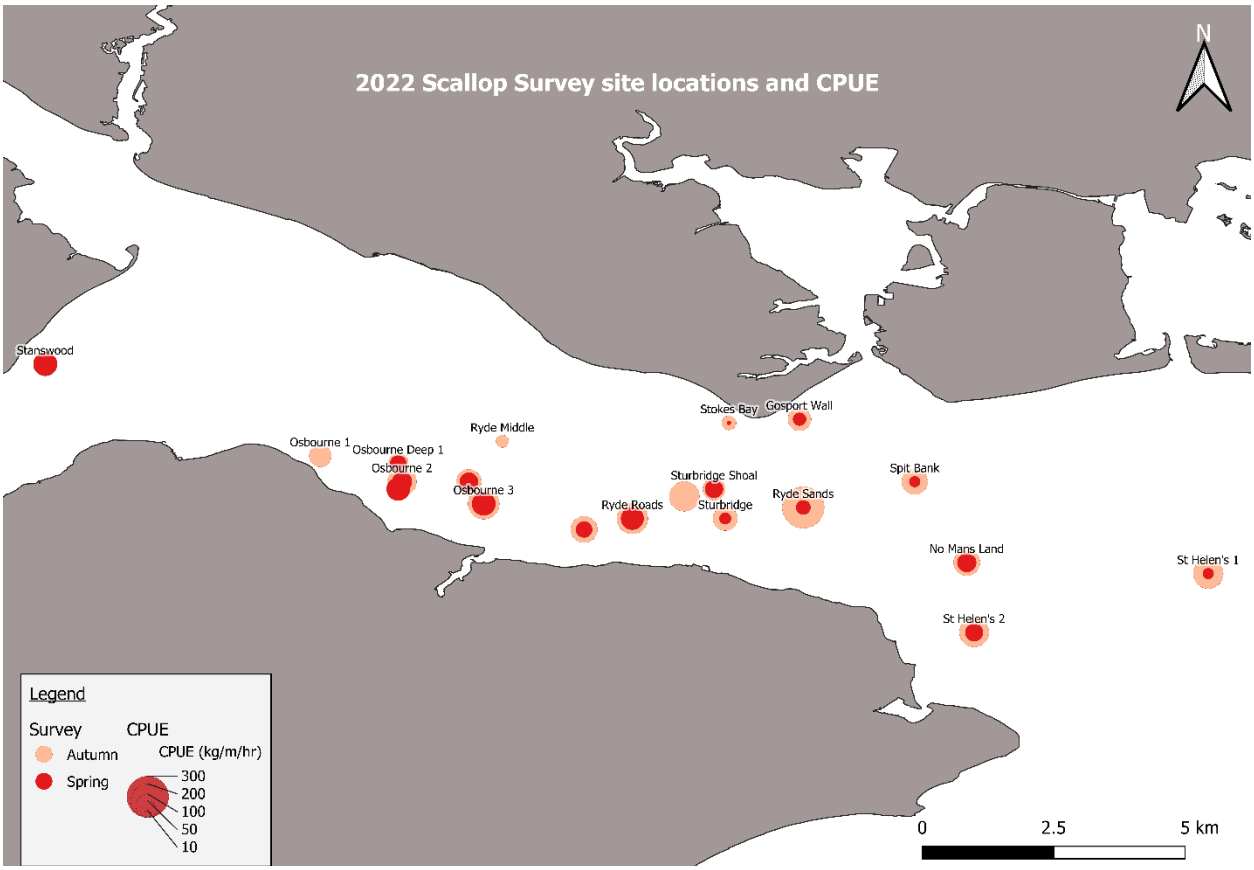

Figure 5: The Catch per Unit Effort (CPUE, kg/m/hr) averaged over the three dredges for each site surveyed in Autumn (Orange) and Spring (Red) 2022. The co-ordinates of the first dredge at each site for Autumn was used to plot both Spring and Autumn 2022 data. The size of the circle represents the average CPUE for that site. Osbourne 1, Ryde Middle and Mother's Bank were not sampled in Spring 2022.

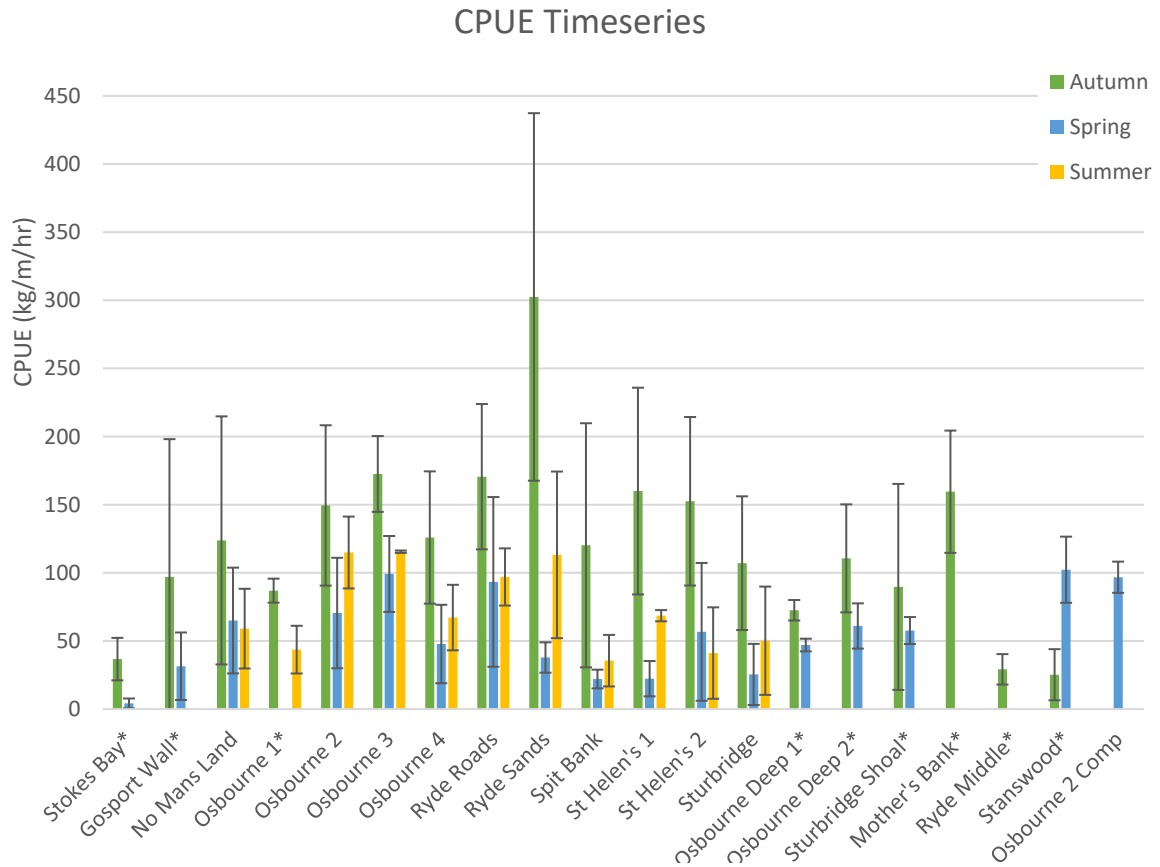

Figure 6: The Total Catch per Unit Effort (CPUE, kg/m/hr) averaged over the three dredges for each site surveyed in Autumn 2022 (green), Spring 2022 (blue) and Summer 2021 (yellow). Error bars show standard deviation from the mean of the 3 dredges.

3.3. Size Frequency

- A visual analysis of the size frequency data from all three survey periods showed that the survey in Autumn 2022 had a wider range of length data than the Spring 2022 and Summer 2021 surveys (Figure 7).
- Comparing the average length of scallops (mm) (all sites combined) between each survey period (Summer 2021, Spring 2022 and Autumn 2022) using a Kruskal-Wallis test and post-hoc Dunn's Method showed that there was a significant effect of survey on length ($H(2) = 18.382$, $P<0.001$).
- The average length in Autumn 2022 (median = 106mm) was significantly shorter than in Summer 2021 (median = 108.6mm) and Spring 2022 (median = 108.7mm) (Figure 7).
- In all three surveys, the median length was shorter than the MCRS for ICES VIId of 110mm.
- As a different number of sites were surveyed during Autumn 2022, Spring 2022 and Summer 2021, at 19, 17 and 11 respectively, the frequency of scallops of different sizes may be influenced by the number of sites sampled. The results do show that no scallops were caught that were greater than 146mm in length in any of the three surveys.

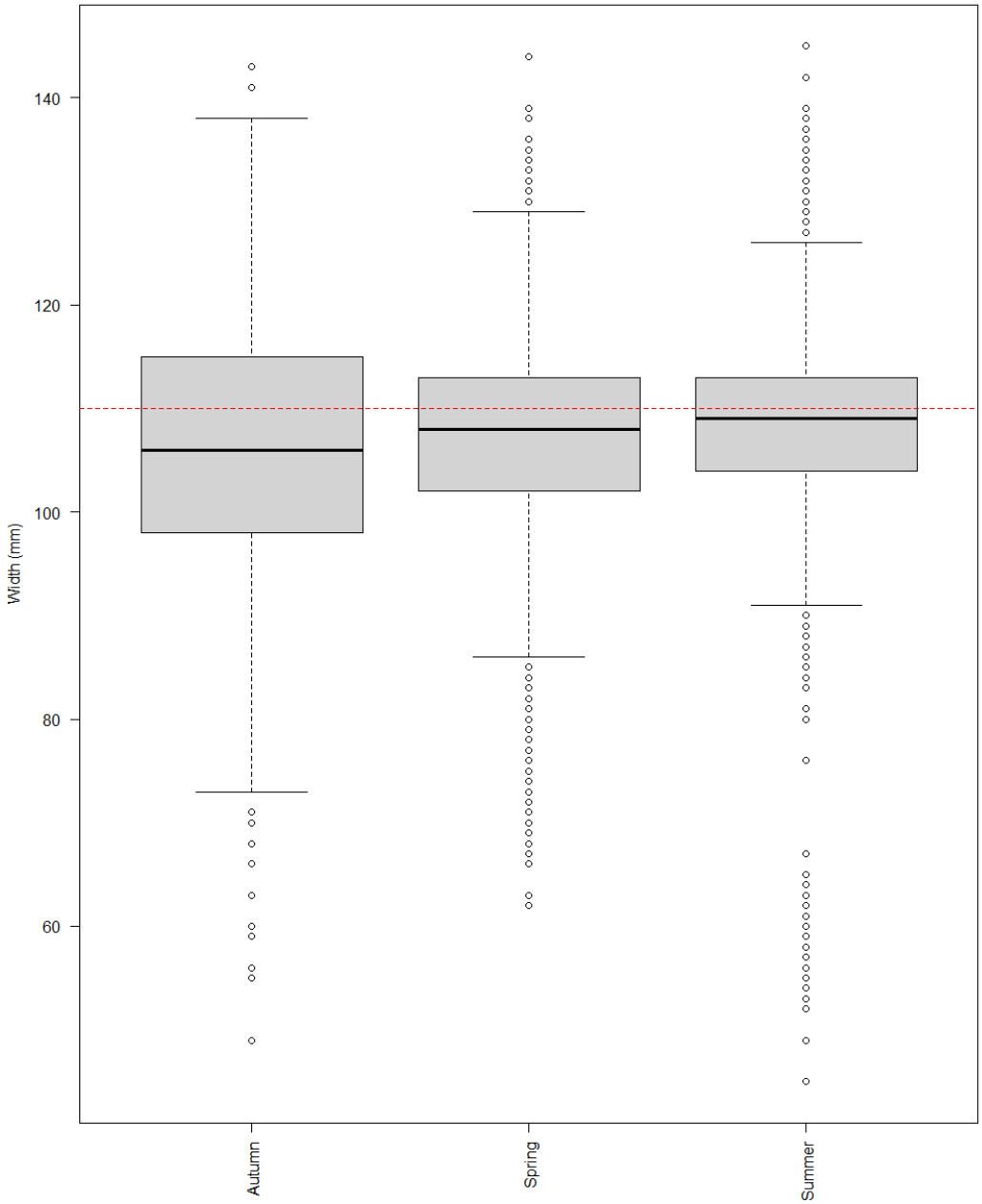

Figure 7: Comparison of the lengths of scallops measured (mm) during the Autumn 2022, Spring 2022 and Summer 2021 surveys. The thick black line shows the median length (mm), the red dotted line represents the minimum size of King scallop in ICES area VIId of 110mm.

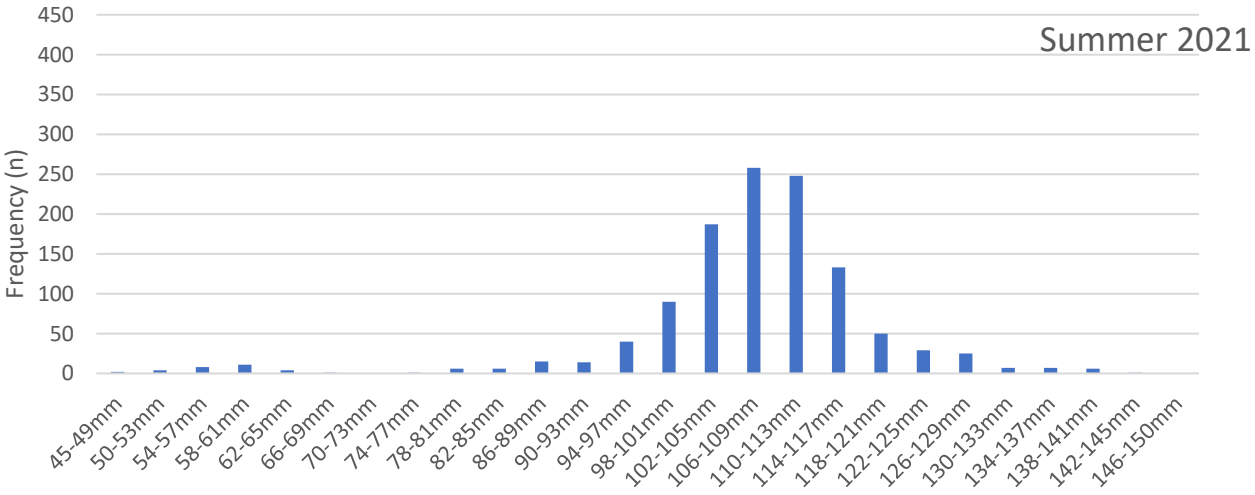

Figure 8: Frequency (n) of scallops caught in the Summer 2021 survey between 45mm and 150mm in 3mm size classes.

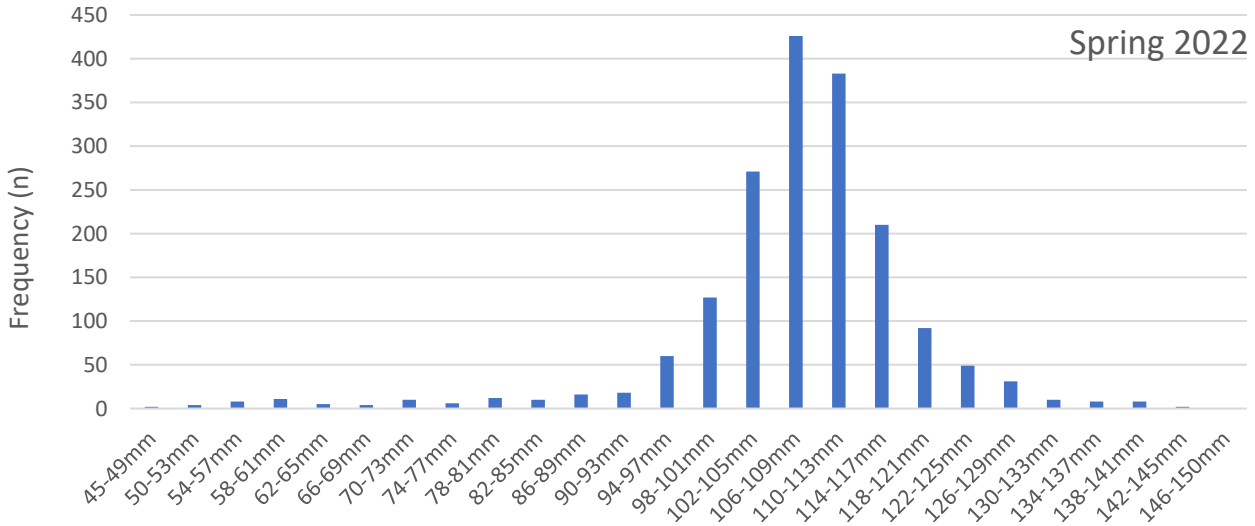

Figure 9: Frequency (n) of scallops caught in the Spring 2022 survey between 45mm and 150mm in 3mm size classes.

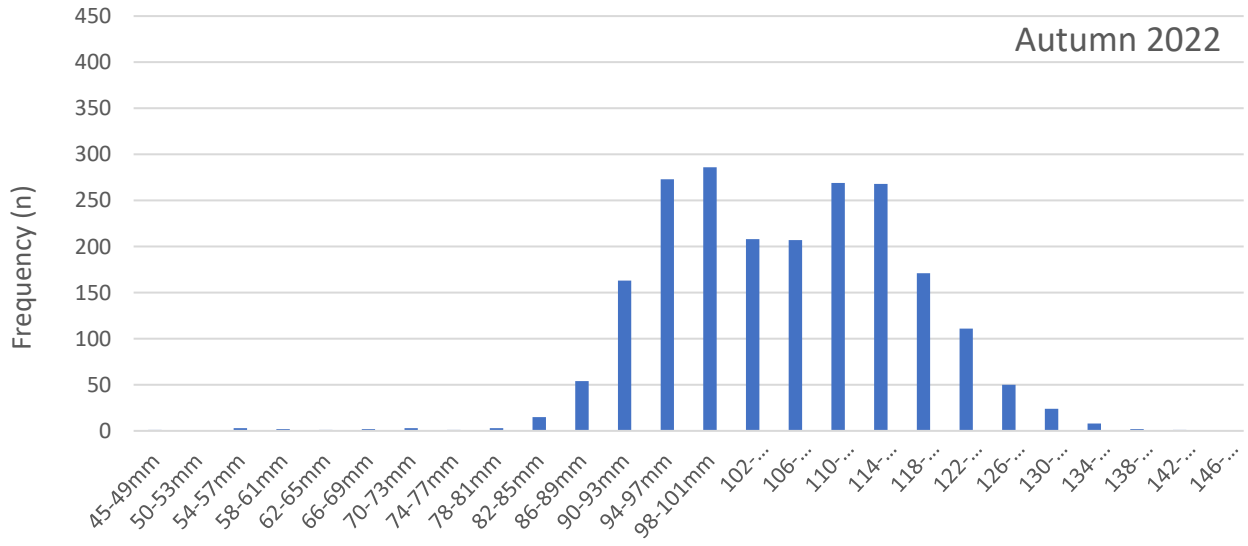

Figure 10: Frequency (n) of scallops caught in the Autumn 2022 survey between 45mm and 150mm in 3mm size classes.

3.3.1. Descriptive analysis

Summer 2021 (Figure 8)

- The distribution follows a bell-shaped curve. The greatest number of scallops were seen in the 106-109mm size class (n=258) with the next highest number in the 110-113mm size class (n=248).
- Small quantities of scallops were seen below the 94-97mm size class.

Spring 2022 (Figure 9)

- The size class frequency of scallops follows a bell-shaped curve. The greatest number of scallops were seen in the 106-109mm size class at n=426 which is just under the MCRS of 110mm. n=383 was seen in the 110-113mm size class.
- Small quantities of scallops were seen below the 94-97mm size class.

Autumn 2022 (Figure 10)

- The greatest number of scallops were seen in the 98-101mm size class at n=286. There are two peaks in the size frequency distribution in Autumn 2022, one at 94-97mm and 98-101mm (n=273 and n=286) and another at 110-113mm and 114-117mm (n=269 and n=268)
- Small quantities of scallops were seen below the 82-85mm size class.

3.3.2. Comparing length between sites for the Spring 2022 and Autumn 2022 surveys

- The average length of scallops was compared between sites for the Spring 2022 and Autumn 2022 surveys using a Kruskal-Wallis test and post-hoc Dunn's Method.
- Analysis of scallops in smaller size classes is caveated with the knowledge that the gear used for sampling is size selective and therefore not all of the population below a certain size will be sampled by the survey methodology, however comparisons can be made between sites and between years as the same methodology is repeated for all surveys.

Spring 2022 (Figure 9)

- For Spring 2022, there was a significant difference in average length between sites ($H(15) = 236.620$, $P<0.001$).
- The average length at Osbourne 3 (100mm), Osbourne 4 (102mm) and Ryde Sands (101mm) were significantly shorter than at Stokes Bay (121mm), St. Helens 1 (117mm), Stanswood (115mm), Gosport Wall (113mm), St. Helens 2 (110mm) and No Mans Land 106mm)
- In addition, the average length at Osbourne 3 (100mm) was also significantly shorter than at Osbourne Deep 2 (109mm) ($p<0.05$).

Autumn 2022 (Figure 10)

- For Autumn 2022, there was also a significant difference in average length between sites ($H(18) = 237.617$, $P<0.001$)
- The average length at Ryde Sands (100mm) and Ryde Roads (100mm) was significantly shorter than all but five of the sites sampled (the five sites with no significant difference were Stokes Bay (110mm), St Helens 2 (105mm), Mothers Bank (103mm), Osbourne 4 (103mm) and comparing the two sites to each other).
- Sites Osbourne 4 (103mm), Mothers Bank (103mm) and St Helens 2 (105mm) also showed a significantly shorter average length than Ryde Middle (114mm), Osbourne 1 (111mm),

Osbourne 2 (110mm), Osbourne Deep 1 (110mm) and Osbourne Deep 2 (110mm)

- Stanswood (120mm) showed a significantly greater average length than 11 of the other sites sampled.
- There is not a consistent pattern in significance between sites for the two surveys (Spring 2022 and Autumn 2022), the only similar results seen in both surveys are shorter average lengths at Ryde Sands (100mm in Autumn and 101mm in Spring) and Osbourne 4 (103mm in Autumn and 102mm in Spring).

4. Summary

The scallop survey has only been completed three times to date, and only two of those surveys have occurred pre and post a scallop dredge season as defined in the Solent Dredge Permit Byelaw with the Spring 2022 survey occurring post the 2021-2022 fishing season and the Autumn 2022 survey occurring pre the 2022-2023 fishing season. Therefore, at this time there is not a sufficient time-series of data to be able to relate the results seen to activity within the Solent scallop fishery.

Further data encompassing multiple fishing seasons is required in order to identify patterns in stock data and, in order to analyse this data in relation to fishing activity, further data is also required from the catch data provided by fishers as required under their permit.

The data from the surveys undertaken in Spring 2022 and Autumn 2022 does show that the method used for the survey is able to provide data on CPUE and size frequency which can be used to analyse the scallop population in the Solent and therefore gives confidence that continuing with this methodology will enable the Southern IFCA to build a time-series dataset which will help support the sustainable management of this fishery and inform future management decisions.