Teign Estuary
Cockle Stock Assessment 2019

Devon & Severn IFCA Inshore Fisheries and Conservation Authority

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1.0 Introduction

The Teign Estuary is situated on the south coast of Devon, and consists of an East-West aligned, broad tidal river channel. It has no current Marine Protected area designation. There has been shellfish harvesting and aquaculture in Devon's estuaries for hundreds of years. The main harvest has been mussels and oysters. Commercial harvesting of mussels (*Mytilus edulis*) and pacific oysters (*Magallana gigas* formally known as *Crassostrea gigas*) occurs in the Teign under the River Teign Mussel Fishery Order 1966 and the River Teign Mussel Fishery (Variation) (Oysters) Order 1995, (Teign Estuary Partnership, 2004). Figures 1 - 3 show the classified shellfish waters and production areas of the Teign Estuary, and the harvesting areas for *M. edulis* and *M. gigas*.

Cerastoderma edule is present within the estuary and has known to be collected at low levels both historically and at the present-day (Edwards 1987, Cefas 2004). Unlike mussels and pacific oysters this population has never reached a large enough level to be harvested commercially from within the estuary. The beds have not been classified for commercial exploitation by Cefas (Figure 2 and Figure 3, Cefas 2013), assessments carried out for the 2000 Water Frame Work Directive fail even to mention the presence of cockle within the estuary. However, cockles are present and concerns about its recreational collection and potential over-exploitation particularly from 'The Salty' have been documented as far back as 2008 (Teign Estuary Partnership, 2008) and continues to date.

Devon and Severn Inshore Fisheries and Conservation Authority (D&S IFCA) understands the communal and ecological importance of these beds and have undertaken survey work to establish the population structure, biomass, and distribution of cockles within the areas of the estuary where cockles are known to be present. This report has been created using previously unavailable data, and its findings will be used as a base line for future cockle reports (2019 onwards) and will inform the Authority during its current review of Hand Gathering within the D&S IFCA's District.

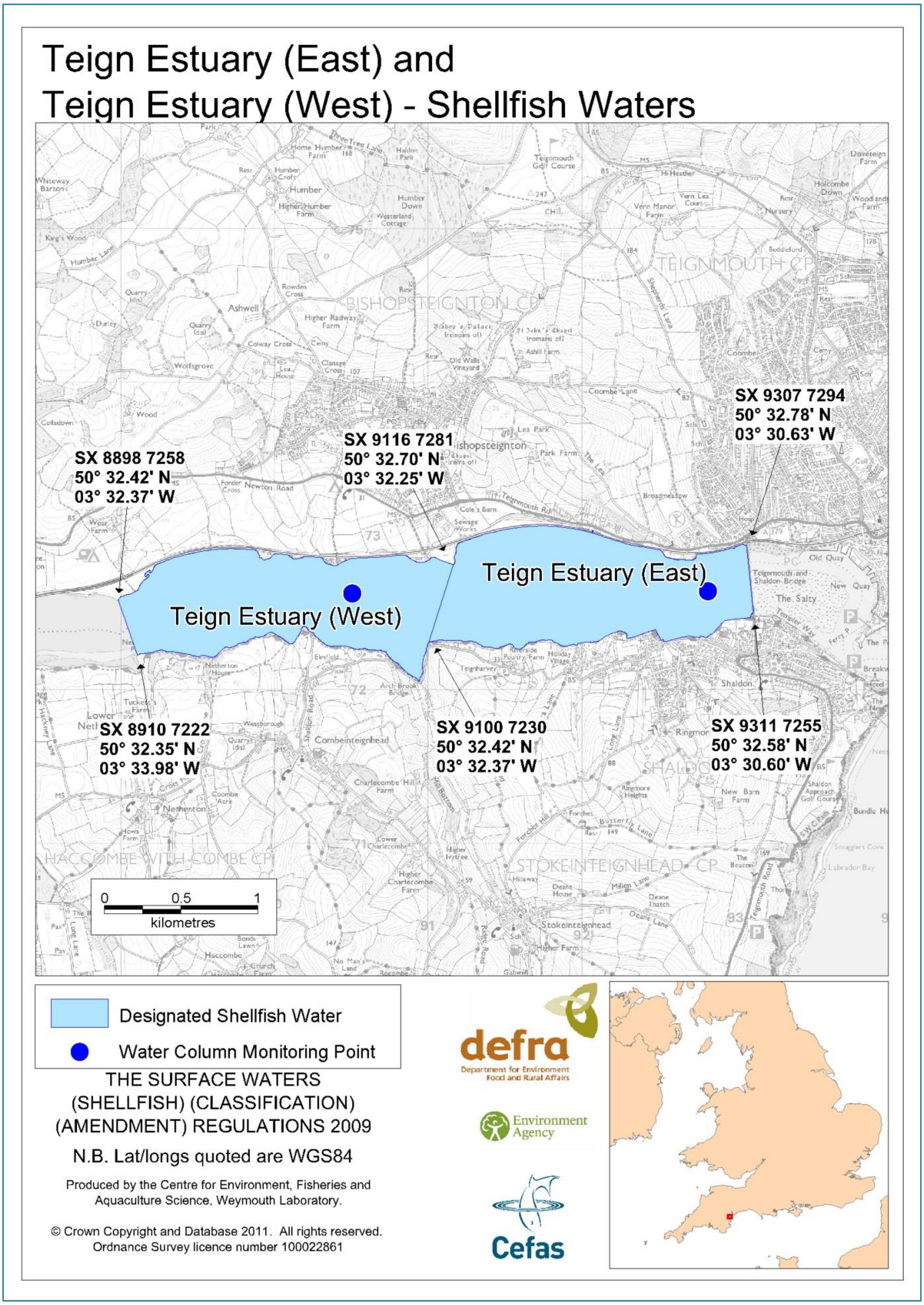
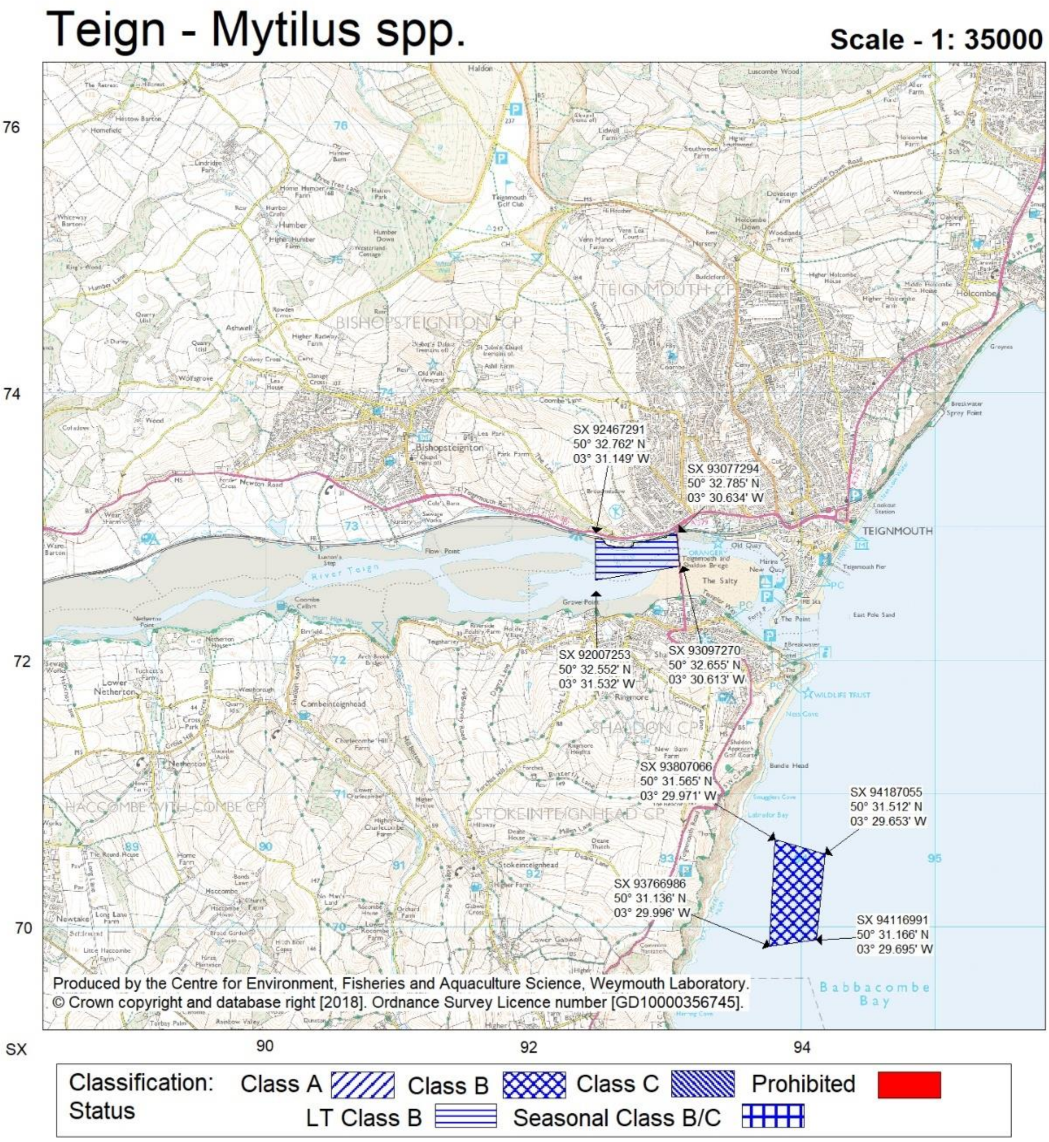


Figure 1. Classified shellfish waters of the Teign Estuary.



Classification of Bivalve Mollusc Production Areas: Effective from 1 July 2019

The areas delineated above are those classified as bivalve mollusc production areas under EU Regulation 854/2004.

Further details on the classified species and the areas may be obtained from the responsible Food Authority. Enquiries regarding the maps should be directed to: Shellfish Microbiology, CEFAS Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB.
(Tel: 01305 206600 Fax: 01305 206601)

N.B. Lat/Longs quoted are WGS84
Unless otherwise stated, non-straight line boundaries between co-ordinates follow the OS 1:25,000 mean high water line.

Separate map available for C. gigas at Teign

Food Authority: Teignbridge District Council

Figure 2. Classified harvesting areas for *Mytilus edulis*.

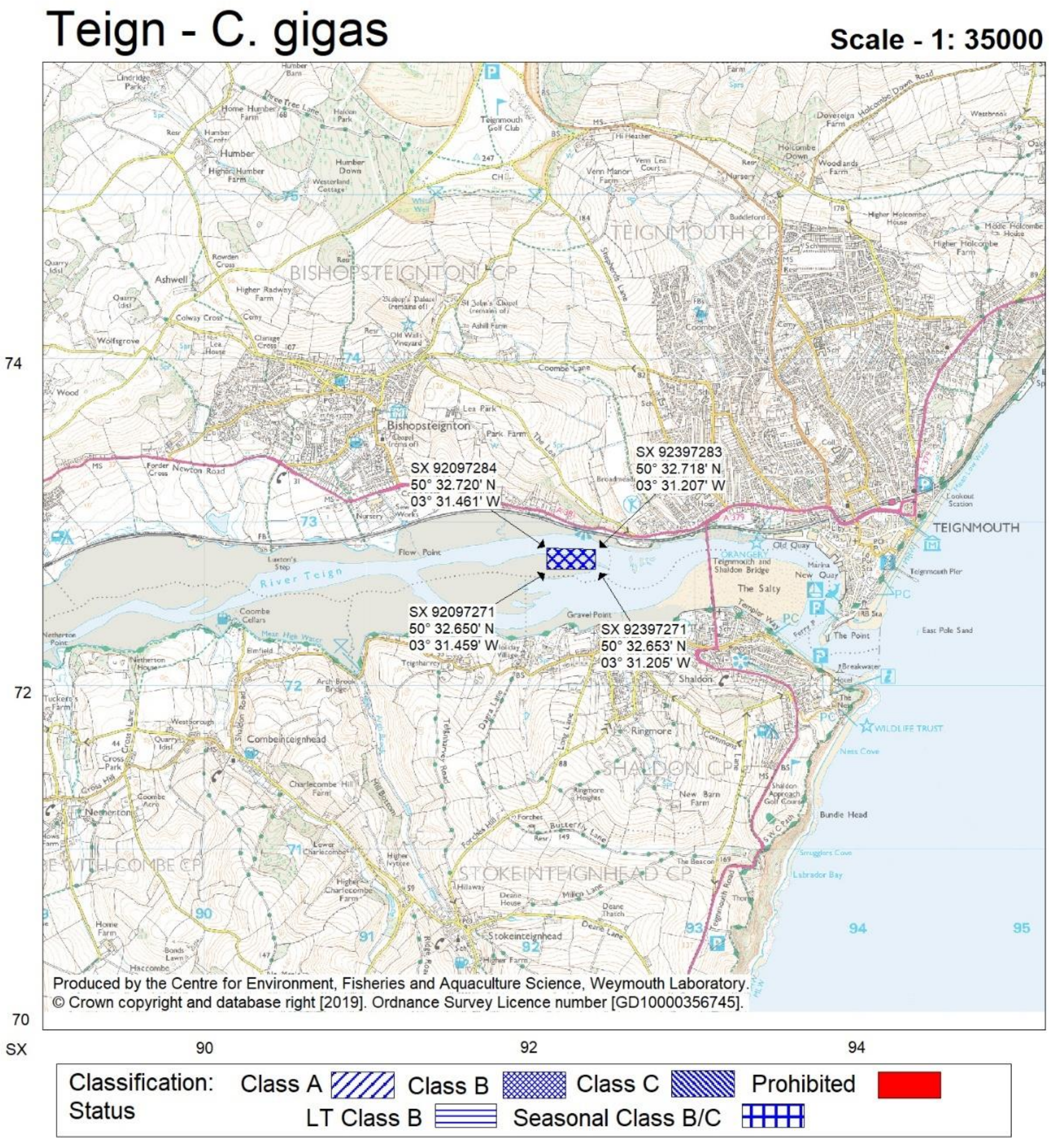


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Figure 3. Classified harvesting areas for *Crassostrea gigas*.

2.0 Methods

The survey was carried out on the 28th of September and 28th- 29th October 2019 over low spring tides. The survey took place across The Salty and upstream of the Shaldon Bridge, with six stations sampled at Polly Steps. The intertidal survey area was designated over the area historically known to contain cockles and where harvesting has been observed. Stations were placed at fixed lateral and linear distances 73.3m between adjacent stations across the intertidal areas, as shown in **Figure 4**. On site a handheld GPS was used to locate the first station e.g. A1 and a quadrat was randomly placed within 10m of the target position for that station. Using a trowel, the sediment was dug out of a 0.1m^2 quadrat, to a minimum depth of 6cm. This was then placed into a sieve and then sifted in water nearby. The cockles were put into a sample bag with a label of the station name (one bag per station). If no cockles were found or the station was unable to be surveyed it was noted. This was repeated at all stations.

For each station sample, cockles were measured using callipers to the nearest millimetre for length and width Figure 5. After measuring, cockles were sorted into age classes by determining how many annual growth rings were present on the shell , which tend to be put down each winter e.g. 0 rings = current year, 1 ring = 1st winter /1 year, 2 rings = second winter/ 2 years and so on. Each year group, from that station, was weighed separately (to the nearest 1g) and recorded. This was repeated for all station samples and once finished all the cockles were returned to the estuary. Some stations were unable to be sampled due to tidal constraints and areas of deep soft mud.

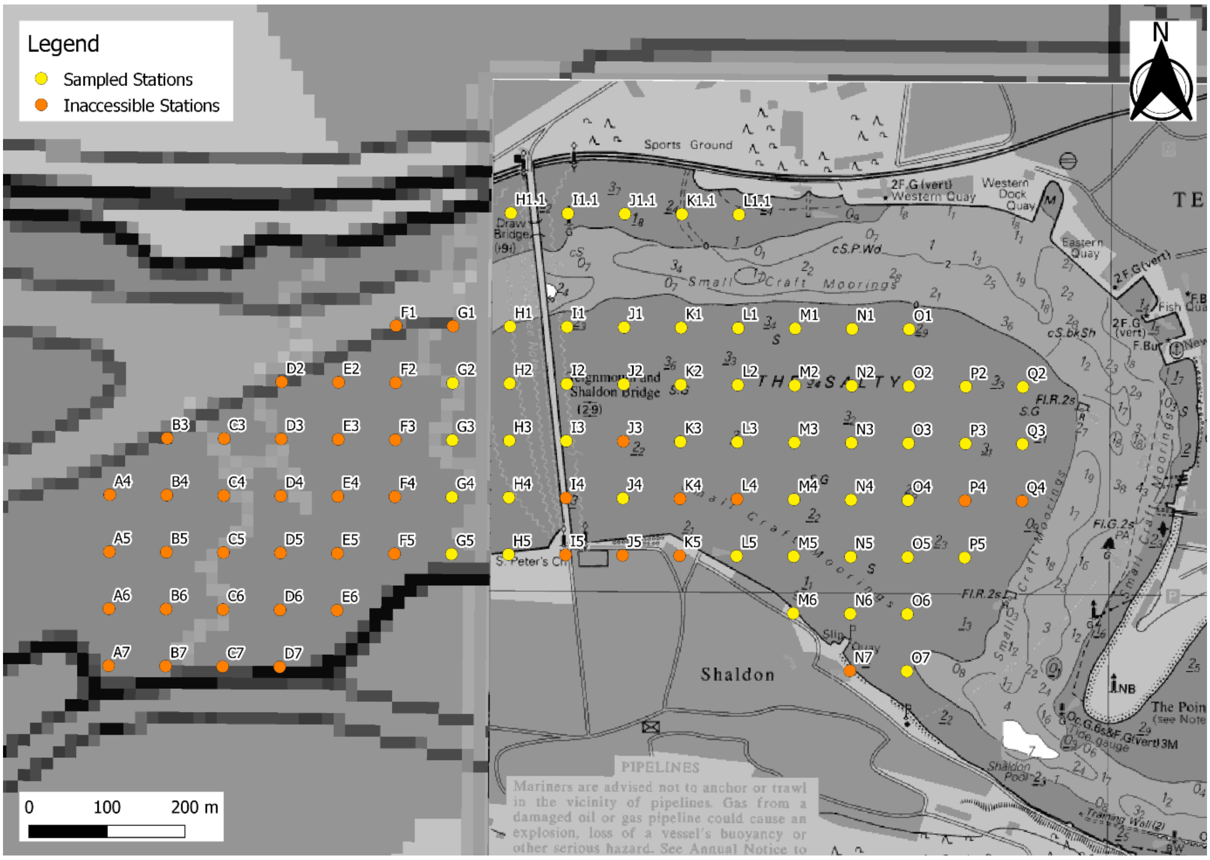

Figure 4 Cockle Survey Stations within the Teign

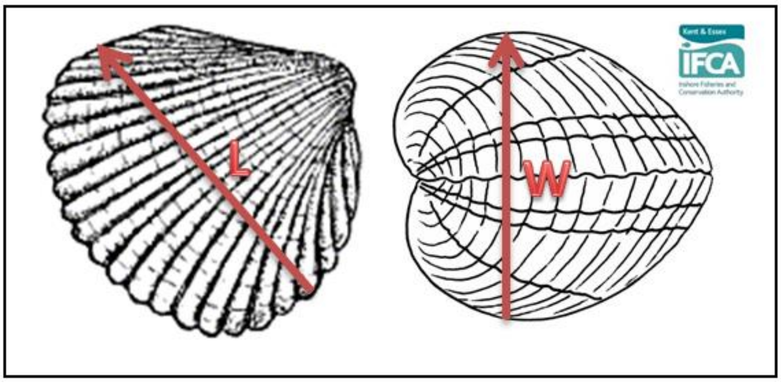

Figure 5 Cockle Length and Width Measurements.

Data from these surveys were entered into Microsoft Excel and size-frequency and year-class graphs were produced. To determine cockle density, the data were transferred into QGIS V3.4 software to produce the density and biomass maps seen in **Figure 9** and **Figure 10,** which was made using custom ranges. The biomass has been calculated from the mean weight and cockle bed area. Although there is no Minimum Conservation Reference Size (MCRS) applied to cockles in the D&S IFCA's District, the stock is divided into two size groups (cockles that are 16mm width and over, and those that are under 16mm) in accordance with other IFCAs' MCRS (Haywood *et al.* 2017; Jessop, 2015).

3.0 Results

Of the 92 proposed sample stations, 50 stations were surveyed the other 42 were inaccessible to survey, see **Figure 4**. Of these, the width of sampled cockles ranged from 4 - 28mm, with a mean width of 16.20 mm. Mean width decreased from 17.61 mm in 2018 to 16.1mm in 2019, as seen in Figure **8**. **Figure 7** shows the size frequency distribution and indicates that 60.2% of the sampled cockles were ≥16mm. Mean Cockle density was 720g per m^2. The estimated total cockle biomass within the Teign was 135.30 tonnes, or 5.03 tonnes/ha. Mean biomass (g/m^2) was highest around the 2008-2010 age classes, mean density was highest between 2016 – 2018 Year class, **Figure 11**.

Spatial density n/m^2 was relatively high across the survey stations, this density was more strongly concentrated within stations closer to the centre of The Salty with a moderately dense population at Polly Steps. Cockle density was lower upstream of Shaldon Bridge and the southern extent of The Salty as seen in Figure **9**.

Cockle biomass (g/m^2) was also relatively high across the middle of The Salty, and towards the channel. Cockle biomass was lower upstream of Shaldon Bridge and the southern extent of the Salty, **Figure 10.** The population at Polly Steps was patchy.

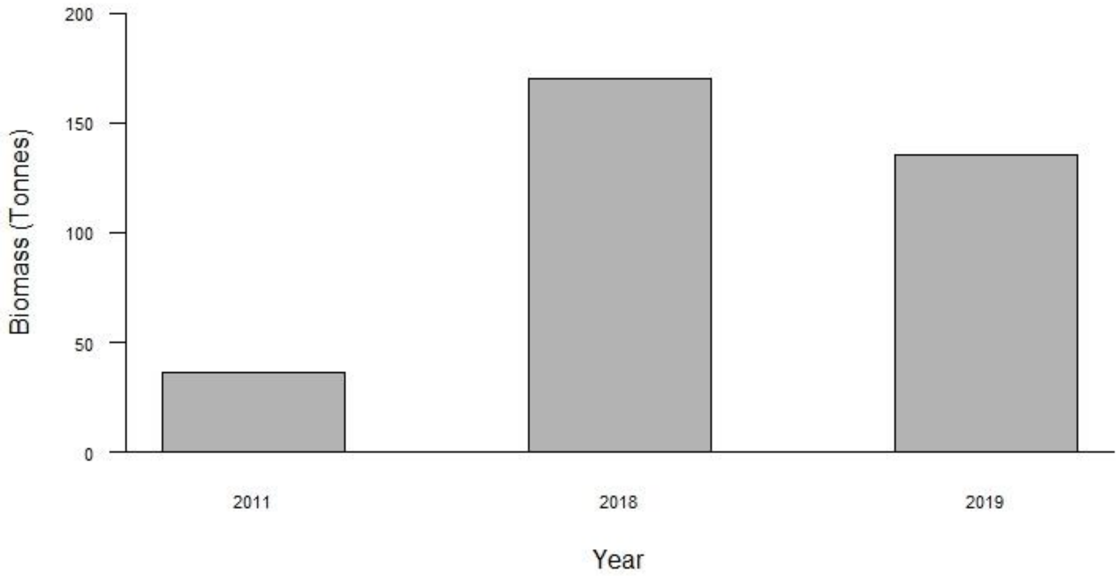

Figure 6 Cockle Biomass within the Teign across years.

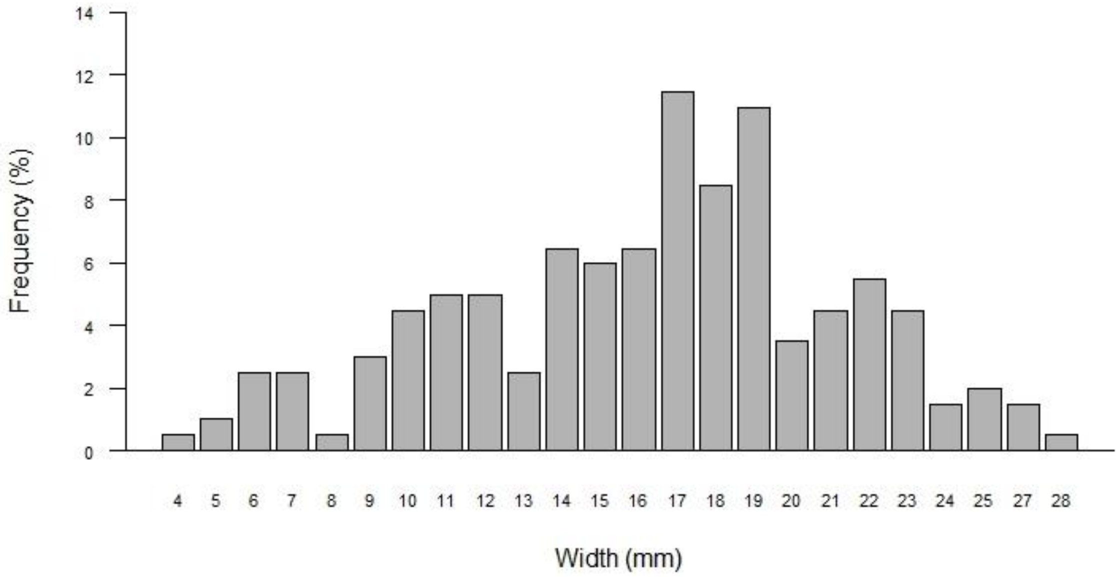

Figure 7 Size frequency graph of sampled Cockles, n of sampled cockles = 201.

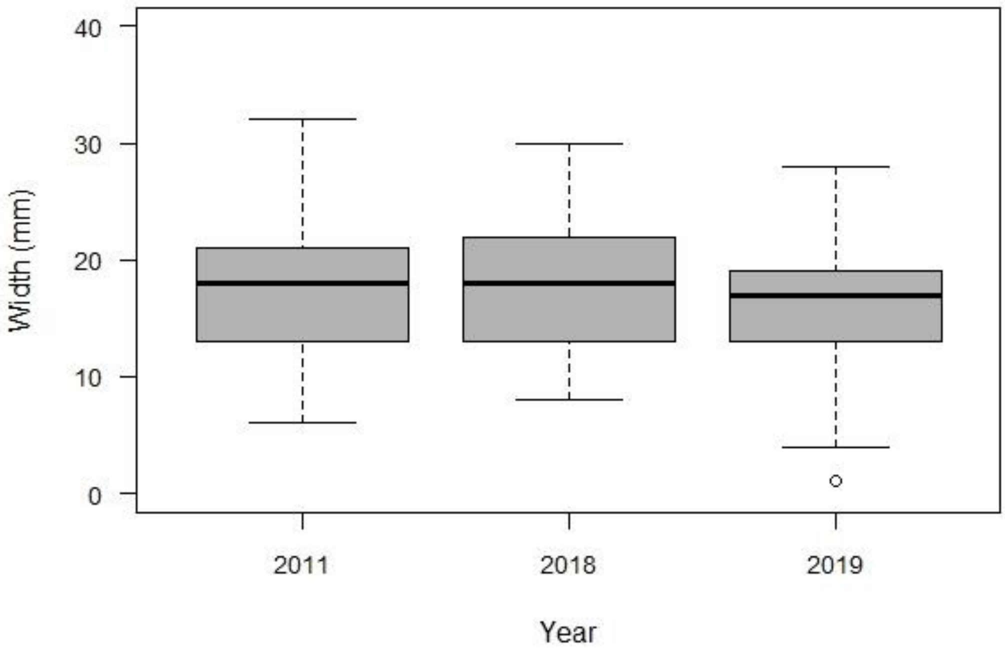

Figure 8 Total width of sampled Cockles per year. Bar represents median (med) value. (2011 n = 152, med = 18mm, mean = 17.1mm), (2018 n = 60, med = 18mm, mean = 17.6mm), (2019: n = 201, med = 17mm, mean = 16.1mm)

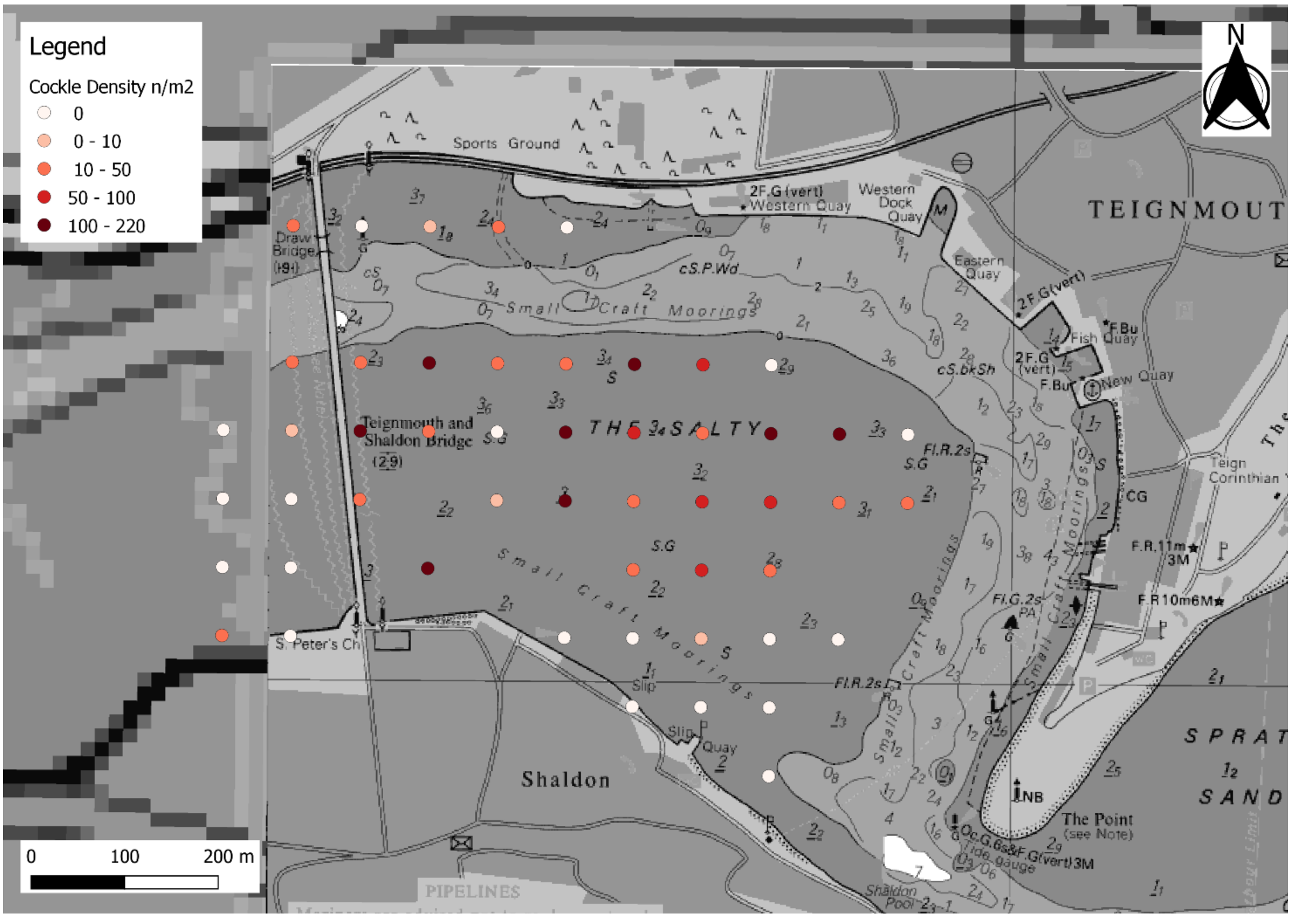

Figure 9 Cockle density per m² across surveyed stations.

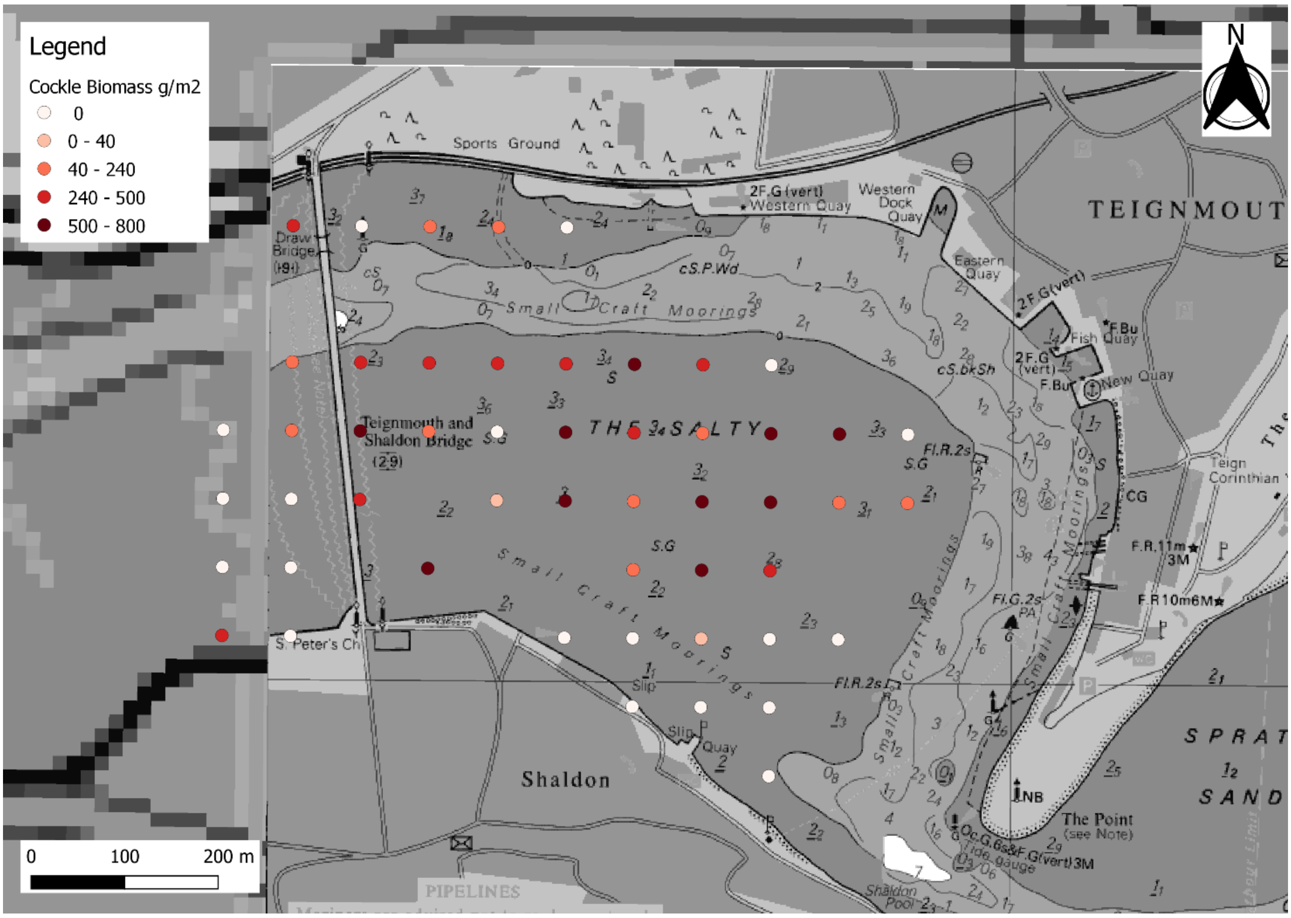

Figure 10 Cockle Biomass per m² across surveyed stations.

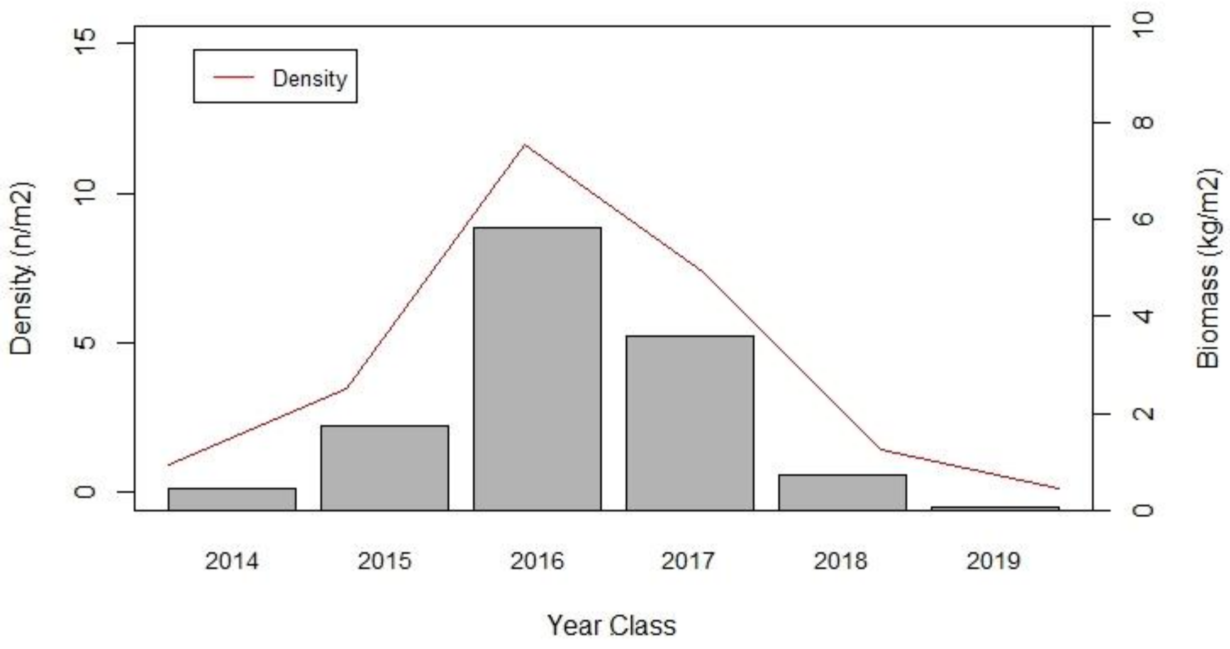

Figure 11 Total cockle biomass and mean density plotted per year class across all surveyed stations. (2014 mean biomass = 0.92g/m^2), (2015 mean = 3.48g/m^2), (2016 mean = 11.64g/m^2), (2017 mean = 7.22 g/m^2), (2018 mean = 1.44 g/m^2), (2019 mean = 0.14g/m^2).

4.0 Discussion

Comparison of cockle biomass within the Teign Estuary, as seen in **Figure 6**, shows some annual differences, notably the increase in cockle biomass from 2011-2018. This vast increase in biomass could be likely attributed to a wide range of contributing factors, from decreased harvesting, improved water quality, favourable oceanographic conditions, reduced sediment loads and inherent natural variability (Ducrotoy *et al*., 1991, Fretter & Graham, 1964, Whitton et al., 2015). One potential cause for an increase in biomass is the increase in survey area. The survey in 2011 covered only The Salty. In 2018 this expanded to include the immediate assessable area upstream of Shaldon Bridge, and in 2019 this further expanded to include Polly Steps. Although the cockle biomass upstream of the Shaldon Bridge does not make up a significant portion of the sampled biomass for either 2018 or 2019, its absence from the 2011 cockle survey means that the total estimation for 2011 is an underestimation when compared to 2018-19. A decrease in biomass was seen in 2019 despite seeing an increase in total area surveyed, with moderate density and biomass of cockle being discovered at Polly Steps. This suggests that the decrease in cockle biomass between 2018 and 2019, as seen in **Figure 6,** may be a conservative estimation, the actual decrease is unknown and may have been higher.

The mean width of cockles sampled in 2019 decreased compared to previous sampled years by around 1-1.5mm, see Figure **8**. This figure represents an increase in the amount of small juvenile cockle found and a decrease in larger mature cockles since 2018. As the data are limited it is difficult to ascertain why there is a decrease in the mean width. It may be due to natural variation in annual growth or potentially due to other factors such as harvesting on the larger cockles from the Estuary. Further annual surveys may help identify if this an on-going trend.

High cockle density and biomass in the centre of The Salty suggest that the central nature of the location provides optimal cockle habitat (**Figure 9, Figure 10).** The sediment (a mix of sandy gravel) in the centre by location is more stable than the sediment by the bridge and seaward extent of the sand bank. These fringing sediments are subject to increasing scour by the tide and as a result are more mobile than the packed sediment towards the centre of the sandbank (Dalrymple & Rhodes, 1995). Cockle Biomass and Density is also higher in intertidal areas subject to increased submergence times and in proximity to and within local hydrological features such as channels and tidal pools. Cockles typically display preference towards stable submerged or intertidal muddy and sandy habitats, where if conditions are favourable (salinity, access to food, temperature, recruitment of juveniles can be facilitated etc) then populations can thrive (Boyden & Russell, 1972; Brock, 1979; Guillou & Tartu, 1994; Whitton et al, 2015,). The opposite of this assumption can equally apply for those areas where cockle density/biomass is low or absent. It may be worth bearing in mind that due to the constraints of the sampling regime taking multiple samples per station was not possible, the reliability of results is therefore lower when analysing individual stations rather than a greater sampling regime across a larger area.

Biomass and density of cockles were particularly high in the central year classes 2016 and 2017, tapering off towards the younger and older year classes **Figure 11**. This suggests increased mortality (natural and fishing) of cockles >4 years old and low recruitment of cockles <2 years old whist the 3 and 4-year-old cockle cohort population seems relatively stable, both in terms of density and biomass. The literature implies that sustained low levels of recruitment could lead to declines in the population over time (Olaffsson *et al.*, 1994). Reasons for low recruitment occurrences may include but are not limited to physical disturbance, such as increased sediment loading, modified flow rate, and high mortality of planktonic larvae in the water column (Olaffsson *et al.*, 1994). The literature also highlights that cockle populations are also naturally subject to high levels of variation at the population and spatial level, this variation is considered a normal feature of *Cerastoderma edule* populations. Therefore, decreased recruitment even if appearing sustained may be part of this natural population variation and not necessarily an indication of population decline. Observing the long-term population trends is therefore vital to understanding the population dynamics of any given cockle population (Jensen 1993; Whitton et al., 2015).

Recommendations for future survey work include using the same station co-ordinates used in this report for subsequent annual surveys. This will allow for direct annual comparisons of station data. These data will be a valuable when analysing spatial population dynamics on a long-term basis and will increase the reliability of future comparisons.

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