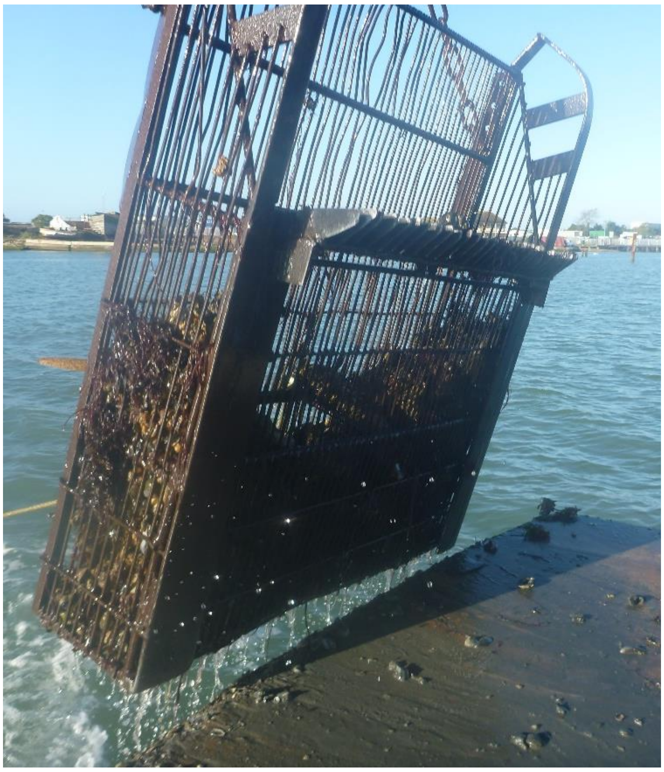
Southampton Water

Bivalve Stock Survey 2017



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1. Introduction

This is the first report on the 2017 survey to assess the population of bivalve species, in particular the Manila clam (*Ruditapes philippinarum*) and the Common cockle (*Cerastoderma edule*) in Southampton Water, Hampshire, UK. This survey was carried out for the first time in 2017 using a local fishing vessel and dredge equipment used by the commercial clam dredge fishery in this area to sample for these bivalve species across a number of defined shellfish beds within the area of Southampton Water. The aim is to repeat this survey annually to create a dataset on the stocks of commercially important clam and cockle species and to monitor trends in abundance and density between different shellfish beds and over time. The outcomes from this survey will provide data on the clam and cockle species populations which can be used as a baseline on which to monitor future changes and trends, and how these relate to current and proposed management measures for the clam dredge fishery.

1.1 The Fishery

The clam dredge fishery currently operates all year round within Southampton Water and the wider Solent. The main species fished for is the Manila clam (*Ruditapes philippinarum*) with other species also taken when in suitable quantities such as the American hard-shelled clam (*Mercenaria mercenaria*), the Common cockle *(Cerastoderma edule*) and occasionally the Grooved Carpet Shell clam (*Ruditapes decussatus*). The fishery has been in place for many years and has been subject to different management measures during that time. Activity mainly takes place within Southampton Water with additional activity occurring in Portsmouth and Langstone Harbours and some parts of the wider Solent. The Solent is home to a number of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), it is therefore important that management of fishing activity in these areas is robust, proportionate and appropriate with measures informed by a solid evidence base.

The clam dredge fishery uses a type of mechanical dredge, commonly referred to as a ‘box clam dredge’ (Figure 1.1). The dredge consists of a metal frame with a front opening beneath which is a row of metal teeth. The dredge is towed from the stern of the vessel, supported on the seabed by skis which are fixed to the base of the dredge, with the teeth digging into the sediment as the dredge is towed. As the dredge moves through the sediment, the teeth disturb the shellfish and cause them to be caught in the basket of the dredge. The basket consists of a metal cage construction with spacing between the bars to allow sediment, debris and smaller sized shellfish to be washed through whilst retaining the sizable shellfish. The dredge is then recovered and held at the surface to allow sea water to wash through the contents reducing the amount of sediment that is collected. The dredge is then brought inboard and emptied onto a sorting table at which point the catch can be sorted.

Vessels commonly use up to two of these clam dredges at a time. The overall construction can vary between different vessels as there are currently no regulations specifying gear construction for this fishery however the general gear type remains the same. The fishery operates throughout Southampton Water and the wider Solent

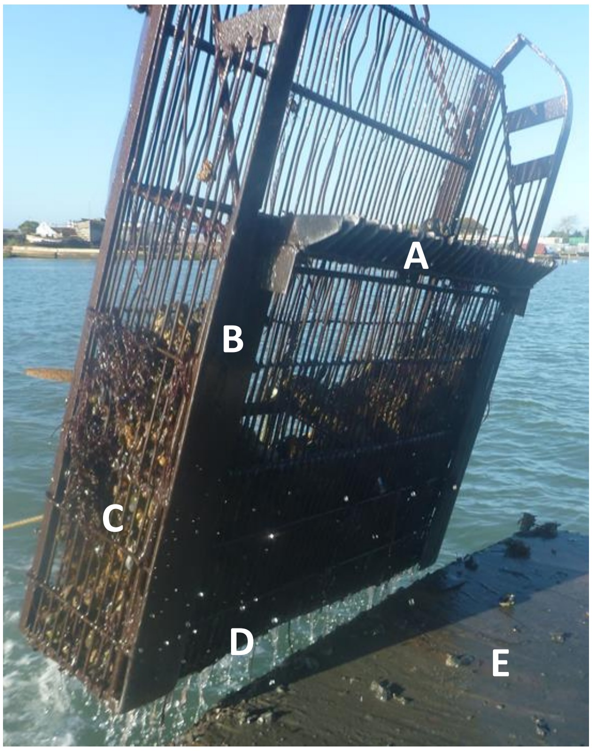


Figure 1.1: a box clam dredge used in Southampton Water; A) metal teeth defining the front opening of the dredge, B) skis to support the dredge on the seabed, C) dredge basket, D) spring-loaded opening to remove contents onto E) sorting table.

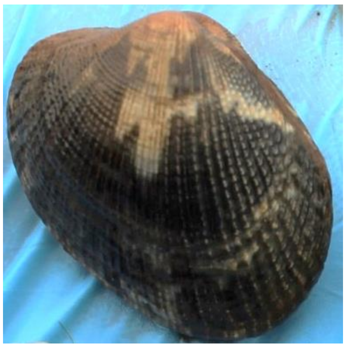
however there are discrete areas where activity is most likely to take place. These areas have developed over time based on the fishers' knowledge of where the larger quantities of clam species are likely to be found. Within Southampton Water there are a number of defined fishing areas, both intertidal and subtidal, which span both the eastern and western sides of the channel. Activity in these areas varies depending on tidal state, time of year and quantities of catch obtained.

The levels of fishing activity in the area of Southampton Water have varied greatly over time. Sightings of fishing vessels compiled by Southern IFCA show that clam dredging occurred predominantly in Southampton Water between 2005 and 2011 (Gravestock, 2016) across a number of areas including Hythe, Bird Pile, Ashlett Creek and adjacent to the entrance to the River Hamble. Data showed a decline in activity in the upper reaches of Southampton Water between 2012 and 2015 corresponding to a change in shellfish classifications in the area prohibiting the fishing for clams. Since 2012 there has also been a decrease in the number of vessels operating within the fishery with only a single vessel often operating on any one day (Gravestock, 2016). Despite the lower levels of activity currently seen, the value of the species caught, particularly Manila clam which can fetch up to £4.50 per kilo, means that the fishery is still used by a number of vessels and is often used in combination with other fishing methods with activity peaking at certain times of year when other fisheries are closed or less productive.

1.2 Commercial Species

The main species harvested by the clam dredge fishery are the Manila clam (*Ruditapes philippinarum*), the American Hard-Shelled clam (*Mercenaria mercenaria*) with incidental catches of the Common cockle (*Cerastoderma edule*) and the Grooved Carpet Shell clam (*Ruditapes decussatus*).

1.2.1 Manila Clam



The Manila clam, *Ruditapes philippinarum* (Adams and Reeve, 1850) is a bivalve mollusc from the family Veneridae. It is found in fine sediments within both the intertidal and sub-littoral (Jensen *et al.,* 2005). Adult clams are suspension feeders, living buried within the sediment. The clam has a planktonic larval stage which allows for natural dispersion, followed by metamorphosis with the clams settling on the seabed (Humphreys *et al.,* 2015). Both adult and larval stages are euryhaline and tolerant of salinities as low as 12-15 which allows the development of estuarine populations (Jensen *et al.,* 2005; Humphreys *et al.,* 2015).

The Manila clam is not native to the UK although its distribution has widened significantly from its native region in the Indo-Pacific to include the Pacific coast of America, the Atlantic coast of Europe and the Adriatic and Aegean seas (Jensen *et al.,* 2004; Jensen *et al.,* 2005). The expansion in the distribution of this species is largely as a result of human activity, the species was first introduced to the UK in the 1980s for the purposes of aquaculture by the Ministry of Agriculture, Fisheries and Food (MAFF) (now DEFRA) after which the species was made available to commercial growers and finally naturalised populations developed, the first of which was reported in Poole Harbour in Dorset (Jensen *et al.,* 2004). It is thought that the species was first found in Southampton Water in 2002 with larger individuals up to 45mm long becoming commonplace by 2005 (Humphreys *et al.,* 2015).

1.2.2 American Hard-Shelled Clam

The American Hard-Shelled clam, *Mercenaria mercenaria* (Linnaeus, 1758) is a bivalve mollusc from the family Veneridae. They are found in muddy/sandy sediments on the lower intertidal and shallow sublittoral, commonly found within estuaries and sheltered bays (Carter, 2005). Adult clams are suspension-feeders and broadcast spawners with a planktonic larval stage of 6-10 days before settling onto suitable muddy/sandy substrate as the shell starts to form (Whetstone *et al.,* 2005). The species has a lower tolerance for low salinities than other clam species and can only exist in low salinity environments for a short period of time (Whetstone *et al.,* 2005).

American Hard-Shelled clams are native to North America although introduced populations occur in Europe and California. The species was purposefully introduced into British waters (Humphreys *et al.,* 2015) and is found in isolated populations on the south coast of England, Pembrokeshire and in Scotland (Carter, 2005).

1.2.3 Common Cockle

The Common Cockle, *Cerastoderma edule* (Linnaeus, 1758) is a bivalve mollusc from the family Cardiidae. The species is found in muddy and sandy habitats at the mid to lower reaches of the intertidal and occasionally in the subtidal. Adults burrow to no more than approximately 5cm below the surface operating as suspension feeders (Tyler-Walters, 2007). The species is a broadcast spawner with larvae living for 3-6 weeks in the plankton before settling on the substrate after metamorphosis. The Common cockle is tolerant of salinities as low as 10 which allows for the development of extensive estuarine populations (Hayward and Ryland, 1995).

The Common cockle is native to the UK and is found distributed around the coasts of Britain and Ireland. Populations are also found from the wester Barents Sea and northern Norway to the Iberian Peninsula and the coast of west Africa.

1.2.4 Grooved Carpet Shell Clam

Image by Joop Trausel and Frans Slieker via www.marinespecies.org

The Grooved Carpet Shell Clam, *Ruditapes decussatus* (Linnaeus, 1758) is a bivalve mollusc from the family Veneridae. It is very similar in appearance to the Manila clam; however, the two species can be identified by their siphon anatomy with the Carpet Shell having distinctly separate inhalant and exhalent siphons compared to the Manila clam where the siphons are fused for most of their length (Humphreys *et al.,* 2015). In addition, the Carpet Shell has distinctive radiating lines on the shell. The Carpet Shell is a suspension feeder and is found on the lower intertidal and shallow sublittoral in sandy, muddy gravel or clay sediments (Haywood and Ryland, 1995). The species is a broadcast spawner with a 10-15 day planktonic larval stage before the larvae settle as spat on suitably sandy and silt substrates (Figueras, 2005).

Figure 1.2: Ariel view of Southampton Water showing the main channel and the three main tributaries, the Test, Itchen and Hamble rivers.

The species is native to the British Isles and is mainly found off the southern and western coasts of Britain and Ireland as well as in the Mediterranean and west Africa (Carter, 2003).

1.3 Southampton Water

Southampton Water (Figure 1.2) is part of the Solent-Southampton Water estuarine system which forms the largest estuary on the south coast of the UK (Levasseur *et al.,* 2007). Southampton Water itself is 2km wide by 10.3km long and is fed by three main tributaries, the Test river, the Itchen river and the Hamble river (Levasseur *et al.,* 2007). At its southern end, Southampton Water splits around the Isle of Wight to form the East and West Solent which in turn feed out into the wider English Channel. Southampton Water is classed as a macrotidal estuary with complicated tidal conditions by virtue of a double peak on the flood tide and a double high water at spring tides (Long *et al.,* 2000).

Southampton Water is designated as a Special Protection Area (SPA) under the Wild Birds Directive (2009) and forms part of the wider Solent European Marine Site (SEMS) which incorporates both Special Protection Areas (SPA) and Special Areas of Conservation (SAC) within the Solent estuary. The Solent EMS is unique in Europe with regard to the complexity of the marine and terrestrial habitats present including mudflats, saltmarsh, eelgrass (*Zostera* spp.) and natural shoreline transitions to adjacent coastal habitats including grazing marsh, saline lagoons and reedbeds (SEMS, 2017).

The Solent and Southampton Water SPA and Ramsar site extends from Hurst Spit to Hill Head along the south coast of Hampshire and from Yarmouth to Whitecliff Bay along the northern coast of the Isle of Wight (Gravestock, 2016). The variety of habitats present, in particular the extensive mudflats, supports a rich invertebrate fauna which in turn provides a food source for internationally important populations of migratory species and an internationally important assemblage of wildfowl (Gravestock, 2016). Fisheries management must take account of the conservation objectives for the site and ensure that the integrity of the site is maintained or restored as appropriate and that the site continues to contribute to achieving the aims of the Wild Birds Directive.

1.4 Current Management

There are a number of measures currently in place regulating clam dredge fishing within Southampton Water and the wider Solent.

<u>Bottom Towed Fishing Gear byelaw</u>

The Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive seagrass and reef features. This byelaw includes closed areas within Southampton Water to protect seagrass features.

<u>The Solent European Marine Site (Prohibition of Method of Dredging) Order 2004</u>

This Order prohibits any fishing vessel from deploying or carrying (unless inboard, secured and stowed) a dredge which is used in conjunction with any means of injecting water into the dredge or in the vicinity of the dredge.

<u>Minimum Size Regulations</u>

Shellfish species that would potentially be taken by the clam dredge fishery are governed by a minimum legal size. The minimum sizes for Manila clam (*Ruditapes philippinarum*) and Grooved Carpet Shell clam (*Ruditapes decussatus*) are defined in European legislation under Council Regulation (EC) 850/98 at 35mm and 40mm respectively. The minimum sizes for both the Common cockle (*Cerastoderma edule*) and the American Hard-Shelled clam (*Mercenaria mercenaria*) are both defined in Southern IFCA byelaws, namely the ‘Fishing for Cockles’ byelaw (23.8mm) and the ‘American Hard Shelled Clams – Minimum Size byelaw’ (63mm).

<u>Other Regulations</u>

In addition to the above regulations, the fishery is also subject to regulations on the classification of shellfish. EC Regulations 853/2004 and 854/2004 set out regulations relating to the commercial production and sale of live bivalve molluscs (clams, cockles, oysters, mussels etc.) from classified production areas. These regulations are implemented by means of the Food Safety and Hygiene (England) Regulations 2013. Data on shellfish waters in England and Wales is compiled by CEFAS using the results of monthly bacteriological sampling. Production areas are then classified by the Food

Standards Agency (FSA) according to the E. coli levels present in the samples. This classification into one of five categories then determines the areas where bivalves can be harvested from and how they have to be treated to ensure they are safe for human consumption. Classifications are defined as follows:

A Class – bivalve molluscs can be harvested for direct human consumption

B Class – bivalve molluscs can be marketed for human consumption after purification in an approved plant or after relaying in an approved class A relaying area or after being subjected to an EC approved heat treatment process

C Class – bivalve molluscs can be marketed for human consumption only after relaying for at least two months in an approved relaying area followed, where necessary, by treatment in a purification centre, or after an EC approved heat treatment process

Prohibited Areas – bivalve molluscs must not be subject to production or be collected

Unclassified Areas – bivalve molluscs must not be subject to production or be collected

Currently, Southampton Water has mixed classifications for the Manila clam and the American Hard-Shelled clam. These include areas where harvesting is prohibited due to high E. Coli levels and there are areas defined as C Class and Long-term B Class.

2. Materials and Methodology

The stock assessment survey was carried out on 3rd October 2017 using the fishing vessel 'Benjamin Guy'. The samples were obtained using a 'box clam dredge' from 12 of pre-defined shellfish beds (Table 2.1 and Figures 2.1-2.3) which were defined in conjunction with fishers, using their knowledge and experience of the areas commonly used by the fishery. Originally 13 beds were defined to be sampled however when sampling bed numbers 5 and 6 were determined to be too small on their own due to obstructions and obstacles to dredging therefore these were combined into one bed. Three dredge tows were completed for each of the shellfish beds according to the following methodology:

- The start time and GPS position, using a Garmin 72H hand-held GPS unit, of the vessel were recorded at the start of the tow
- A waypoint was created at the start of the tow using the hand-held GPS unit and the waypoint number recorded
- The vessel's speed was recorded at the start of the tow and any significant changes in speed during the tow were noted
- The dredge was towed for a period of 1 minute
- The end time and GPS position of the vessel were recorded at the end of the tow
- A waypoint was created at the end of the tow using the hand-held GPS unit and the waypoint number recorded

Shellfish Bed Name	Shellfish Bed ID No.	Shellfish Bed Boundary Point No.	Latitude °N	Longitude °W
1	Calshot	A	50.8199	-1.3099
		B	50.8152	-1.3093
		C	50.8282	-1.3253
		D	50.8290	-1.3200
		E	50.8259	-1.3155
		F	50.8207	-1.3088
2	Fuel Jetty	G	50.8328	-1.3253
		H	50.8369	-1.3359
		J	50.8368	-1.3295
		K	50.8293	-1.3214
3	Bird Pile	L	50.8445	-1.3367
		M	50.8431	-1.3404
		N	50.8460	-1.3497
		O	50.8537	-1.3652
		P	50.8562	-1.3612
4	Deans Lake	Q	50.8566	-1.3621
		R	50.8541	-1.3660
		S	50.8650	-1.3886
		T	50.8671	-1.3851
5+6	Hythe and The Gymp	U	50.8770	-1.3983
		V	50.8759	-1.3995
		W	50.8828	-1.4107
		X	50.8836	-1.4047
		Y	50.8838	-1.4053
		Z	50.8831	-1.4110
		AA	50.8920	-1.4210
		AB	50.8934	-1.4179
		AC	50.8903	-1.4105
7	Marchwood	AD	50.8794	-1.4216
		AE	50.8946	-1.4242
		AF	50.8965	-1.4263
		AG	50.8976	-1.4242
8	Millstone Point (River Itchen 1)	AH	50.9102	-1.3746
		AI	50.9132	-1.3762
		AJ	50.9149	-1.3775
9	Ocean Village (River Itchen 2)	AK	50.8988	-1.3860
		AL	50.8955	-1.3875
10	Weston Shore	AM	50.8891	-1.3841
		AN	50.8837	-1.3846
		AO	50.8760	-1.3663
		AP	50.8778	-1.3662

11	Netley	AQ	50.8705	-1.3525
		AR	50.8690	-1.3548
		AS	50.8618	-1.3429
		AT	50.8634	-1.3410
12	Hamble Spit	AU	50.8528	-1.3241
		AV	50.8497	-1.3262
		AW	50.8400	-1.3144
		AX	50.8487	-1.3111
13	Hook Sands	AY	50.8385	-1.3036
		AZ	50.8375	-1.3085
		BA	50.8304	-1.3008
		BB	50.8245	-1.2817
		BC	50.8290	-1.2733

Table 2.1: Shellfish beds sampled as part of the survey, each bed is identified by a number and a name and defined by a number of fixed points (see Figures 2.1-2.3 for charts showing shellfish bed areas).

- The dredge was recovered in-board and the contents emptied onto the sorting table at the stern of the vessel
- The contents of the dredge on the sorting table were photographed
- The presence/absence of certain species/habitat types was recorded from the dredge contents, where present the abundance was scored from 0-5. The species/habitats recorded were; Slipper Limpet (*Crepidula fornicata*), mud, weed, shell, stone and sand. In addition, wood and brick were found in a number of dredges so, where present, were also scored for abundance (0-5).
- Any bivalve species present in the dredge were retained and placed in a bucket labelled with the bed and tow numbers

From the bivalves retained from each tow, the length was measured along the widest axis (mm), using Vernier callipers, for all species. For the Manila clam, which is the dominant species for the fishery, individuals were separated into above or below the minimum size of 35mm and the weight of each size class was recorded (kg). After this analysis all bivalves were returned to Southampton Water ensuring that they were returned to areas of the same classification from which they were taken. Prior to the survey taking place, the dimensions of the dredge were also recorded.

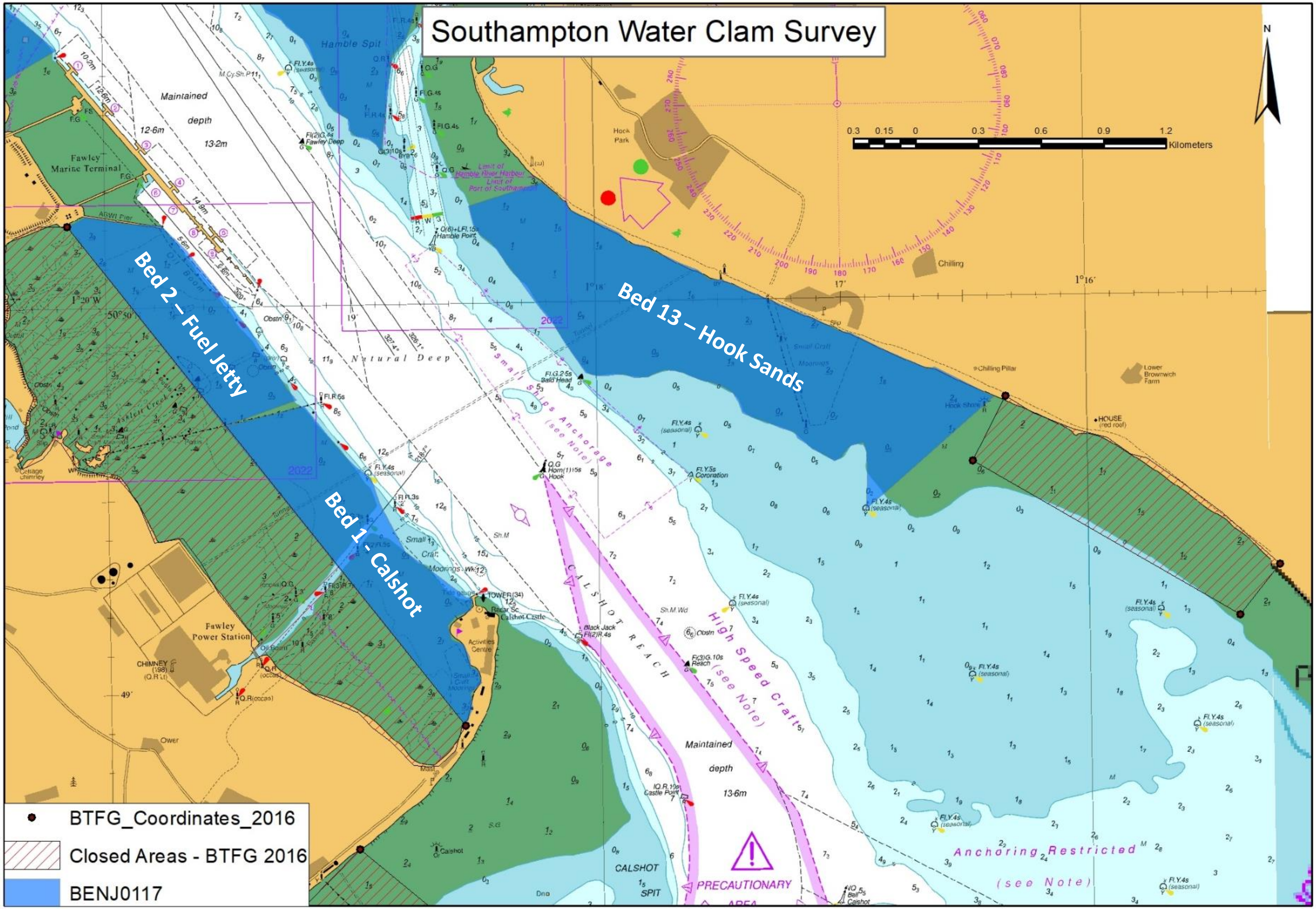


Figure 2.1: Chart showing the location of shellfish beds 1, 2 and 13. The areas proposed to be closed under the Southern IFCA Bottom Towed Fishing Gear byelaw 2016 are also show.

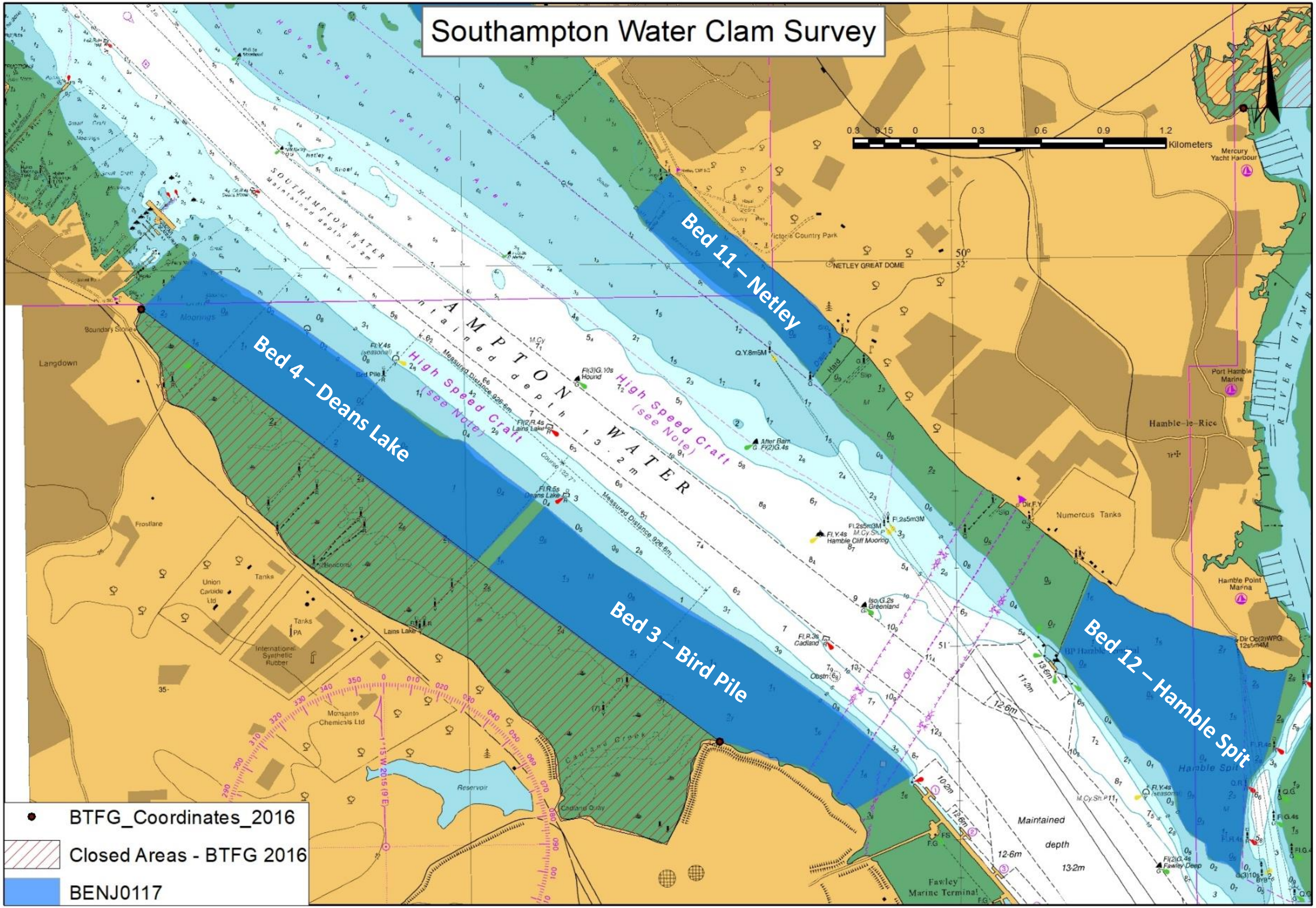


Figure 2.2: Chart showing the location of shellfish beds 3, 4, 11 and 12. The areas proposed to be closed under the Southern IFCA Bottom Towed Fishing Gear byelaw 2016 are also show.

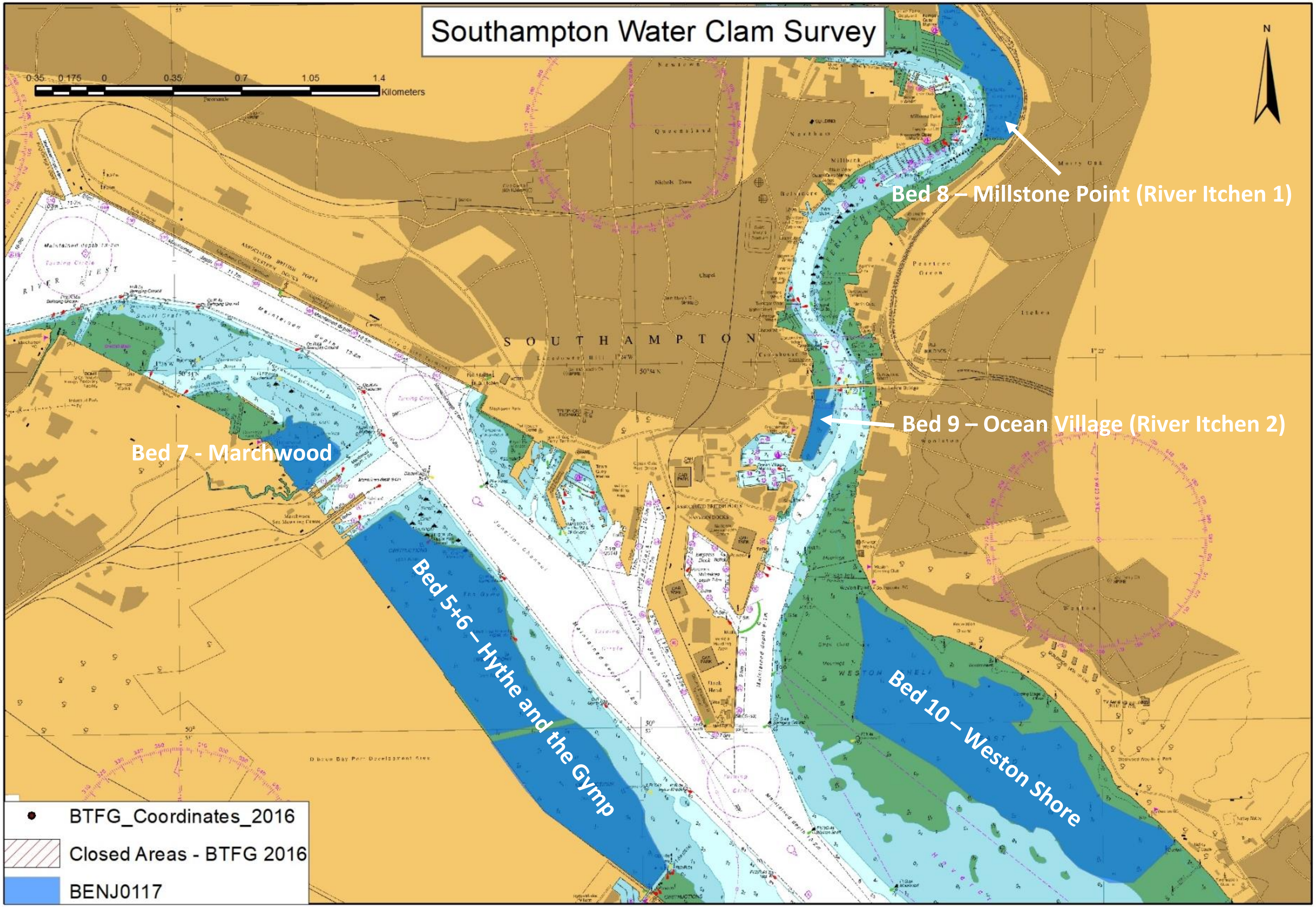


Figure 2.3: Chart showing the location of shellfish beds 5+6, 7. 8. 9 and 10. The areas proposed to be closed under the Southern IFCA Bottom Towed Fishing Gear byelaw 2016 are also show.

2.1 Data Analysis

For the Manila clam, Common cockle and American Hard-Shelled clam the total number of individuals per tow was recorded as well as the number of individuals above and below the minimum size. For all species the length of the individual along the widest axis (mm) was also recorded and for the Manila clam, the total weight (kg) per dredge was recorded as well as the weight of clam above and below the minimum size (kg).

From the tow data, the distance of each tow (m) was calculated based on the GPS co-ordinates taken at the start and end of the tow using a derogation of the haversine formula:

*(ACOS(COS(RADIANS(90-start latitude)) *COS(RADIANS(90-end latitude)) +SIN(RADIANS(90-start latitude)) *SIN(RADIANS(90-end latitude)) *COS(RADIANS(start longitude-end longitude)))*6371)*

This formula gives the great-circle distance between two known points of a sphere. A number of tow lengths were checked to ensure accuracy of the formula using GIS software. Using this data and that of the species recorded, the following calculations were made:

Number of individuals per average tow

From the determined distance of each tow, an average tow distance across all tows was calculated to be 157m. For each tow, the average tow distance was combined with the actual tow distance as calculated above and the number of individuals of a particular species (total, above minimum size and below minimum size) according to the following formula:

*(Number of individuals in tow A / actual distance tow A (m)) * average tow distance (157m)*

This gave a number of individuals per average tow for each shellfish bed, standardising the data and therefore allowing the number of individuals of a particular species to be compared between different shellfish beds.

Number of individuals per m^2 of seabed

The number of individuals per m^2 of seabed was determined for each species for the total number, those below minimum size and those above minimum size. This was determined by dividing the number of individuals in a particular category by the actual tow distance as determined above and then multiplying by the width of the dredge used. As the width of the dredge used was 1m, the calculation was simply the number of individuals divided by the actual tow distance.

Number of individuals per meter of dredge per hour

The number of individuals of each species taken for each tow was also scaled up to look at the number of individuals taken per meter of dredge per hour. This gives a measure of the effort level of the fishery and gives an indication of catch per unit effort (CPUE) as number of individuals of a particular species per hour based on the size of the dredge used. All the tows completed for this survey had a duration of 1 minute. As the width of the dredge was 1m there was no need to multiply by the dredge width therefore the number of individuals per meter of dredge per hour was calculated as the number of individuals for a tow multiplied by 60. This was done for the total number of individuals as well as the number above and below the minimum size.

3. Results

Tables 3.1-3.3 show a summary of some of the results for Manila clam (*Ruditapes philippinarum*), Common cockle (*Cerastoderma edule*) and American Hard-Shelled clam (*Mercenaria mercenaria*) from all the shellfish beds surveyed with data combined for all three dredge tows. The tables show the total number of individuals of each species for each site as well as the size of the largest and smallest individuals and the average size across all measured individuals. In total, 840 Manila clam, 1316 Common cockle and 63 American Hard-Shelled clams were obtained during the survey across all 12 shellfish beds.

Bed ID	Manila Clam			
	Total Number	Largest (mm)	Smallest (mm)	Average (mm)
1	102	45	26	33.94
2	117	40	21	32.82
3	112	42	26	33.17
4	316	43	23	32.71
5+6	24	40	18	30.96
7	15	41	30	35.47
8	48	30	26	38.42
9	1	43	43	43.00
10	27	46	26	34.57
11	41	48	9	33.10
12	17	38	7	22.41
13	20	50	22	34.80

Table 3.1: Summary data for Manila clam showing total number, size of largest and smallest individuals and the average size (mm) for each site, combining data from all three dredge tows.

Bed ID	Cockle			
	Total Number	Largest (mm)	Smallest (mm)	Average (mm)
1	131	36	20	26.11
2	293	34	17	25.66
3	4	25	22	23.00
4	4	28	21	24.75
5+6	42	31	10	25.60
7	39	34	21	27.38
8	125	36	19	28.26
9	35	18	11	15.60
10	263	36	21	26.89
11	1	15	15	15.00
12	3	23	15	18.00
13	376	46	14	24.76

Table 3.2: Summary data for Common cockle showing total number, size of largest and smallest individuals and the average size (mm) for each site, combining data from all three dredge tows.

Bed ID	American Hard-Shelled Clam			
	Total Number	Largest (mm)	Smallest (mm)	Average (mm)
1	12	63	37	50.67
2	2	31	27	29.00
3	0	N/A	N/A	N/A
4	0	N/A	N/A	N/A
5+6	22	82	26	54.05
7	4	52	42	46.75
8	0	N/A	N/A	N/A
9	0	N/A	N/A	N/A
10	7	93	30	60.71
11	13	71	47	57.80
12	3	64	30	42.00
13	0	N/A	N/A	N/A

Table 3.3: Summary data for American Hard-Shelled Clam showing total number, size of largest and smallest individuals and the average size (mm) for each site, combining data from all three dredge tows.

For the Manila clam (Table 3.1), the highest number of individuals found was 316 at site 4 ‘Deans Lake’ and the lowest number of individuals at site 9 ‘Ocean Village (River Itchen 2)’ where only 1 Manila clam was found across all three dredge tows. The average size of individuals measured varied from 22.4mm at site 12 ‘Hamble Spit’ to 43mm at site 9 ‘Ocean Village (River Itchen 2)’, although only one clam was found at this site. The second largest average size was 38.4mm seen at site 8 ‘Millstone Point (River Itchen 1)’. The average sizes for the Manila clams measured were below the minimum landing size of 35mm for 9 out of the 12 shellfish beds sampled.

For the Common cockle (Table 3.2), the highest number of individuals found was 376 at site 13 ‘Hook Sands’ and the lowest number at site 11 ‘Netley’ where only one cockle was found. The average size of individuals varied from 15.0mm at site 11 ‘Netley’ although this is based on only a single individual. Site 9 ‘Ocean Village (River Itchen 2)’ also showed a small average size of 15.6mm. The largest average size was seen at site 8 ‘Millstone Point (River Itchen 1)’ with an average size of 28.26mm. Only four out of the twelve shellfish beds sampled showed an average size less than the minimum size of 23.8mm.

For the American Hard-Shelled clam (Table 3.3), there were far fewer individuals found than for the other two species. The greatest number of individuals was 22 at site 5+6 ‘Hythe and The Gymp’. No individuals were found at five of the sites; site 3 ‘Bird Pile’, site 4 ‘Deans Lake’, site 8 ‘Millstone Point (River Itchen 1)’, site 9 ‘Ocean Village (River Itchen 2)’ and site 13 ‘Hook Sands’. The average size of individuals varied from 29.0mm at site 2 ‘Fuel Jetty’ to 60.7mm at site 10 ‘Weston Shore’. None of the shellfish beds sampled returned an average size of over the minimum size of 63mm.

3.1 Length Frequency Data

For the Manila clam and Common cockle, histograms were produced to show the length frequency distribution of each species for each of the shellfish beds (Figures 3.1 and 3.2). For the Manila clam (Figure 3.1), at the majority of sites there was a dominance of individuals below the minimum size of 35mm. Only sites 7 ‘Marchwood’, site 8 ‘Millstone Point (Itchen River 1)’ and site 9 ‘Ocean Village (Itchen River 2)’ showed a higher percentage of individuals above the minimum size at 53.3%, 68.8% and 100% respectively (although for site 9 only one clam was found).

For the Common cockle (Figure 3.2), the majority of sites had individuals above the minimum size of 23.8mm. Only sites 9 ‘Ocean Village (River Itchen 2)’, 11 ‘Netley’ and 12 ‘Hamble Spit’ showed a higher proportion of individuals below the minimum size (for sites 11 and 12 this is only based on 1 and 3 cockles found respectively).

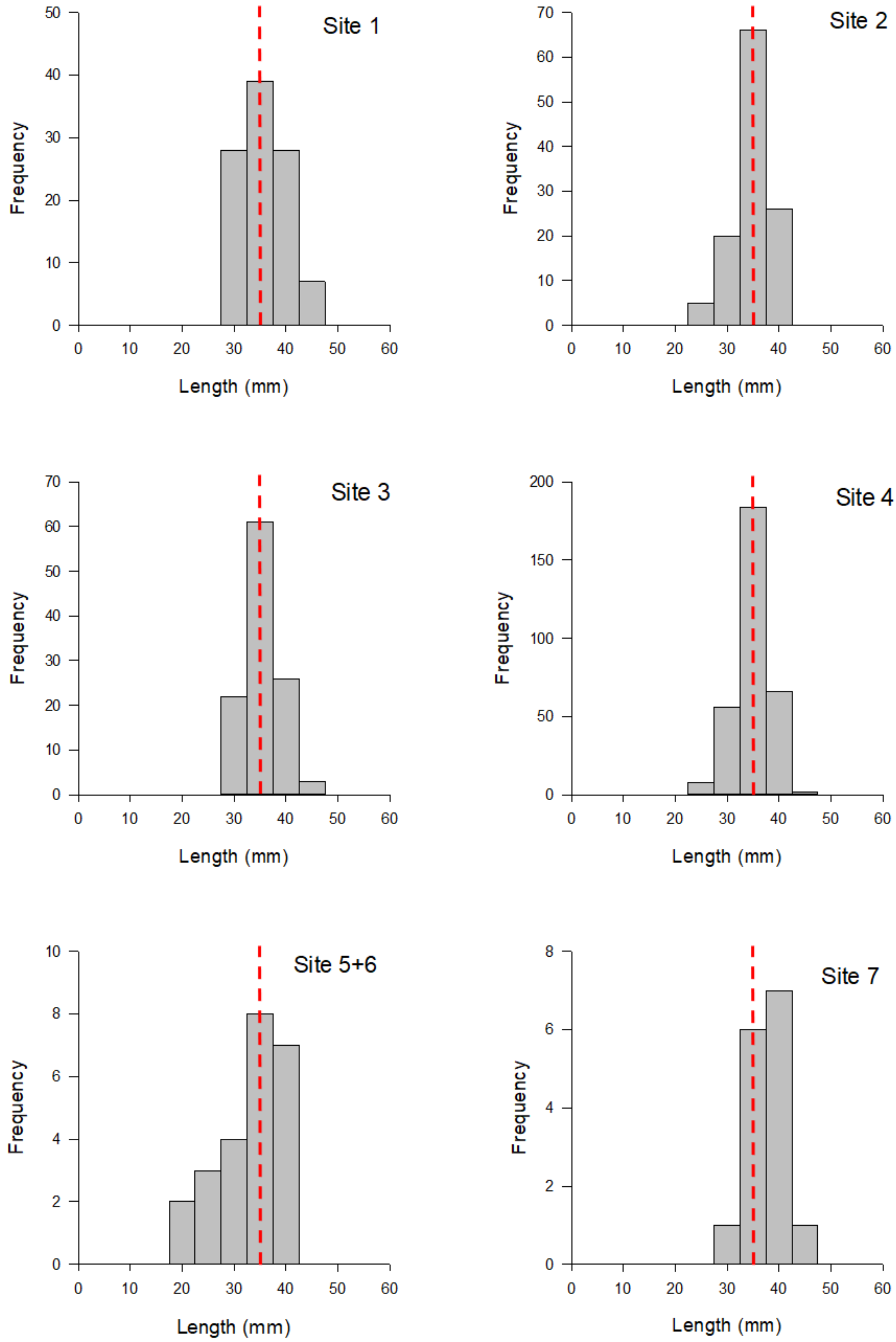


Figure 3.1: Histograms of the length frequency of Manila clam for each site sampled. The red dashed line indicates the minimum size of 35mm.

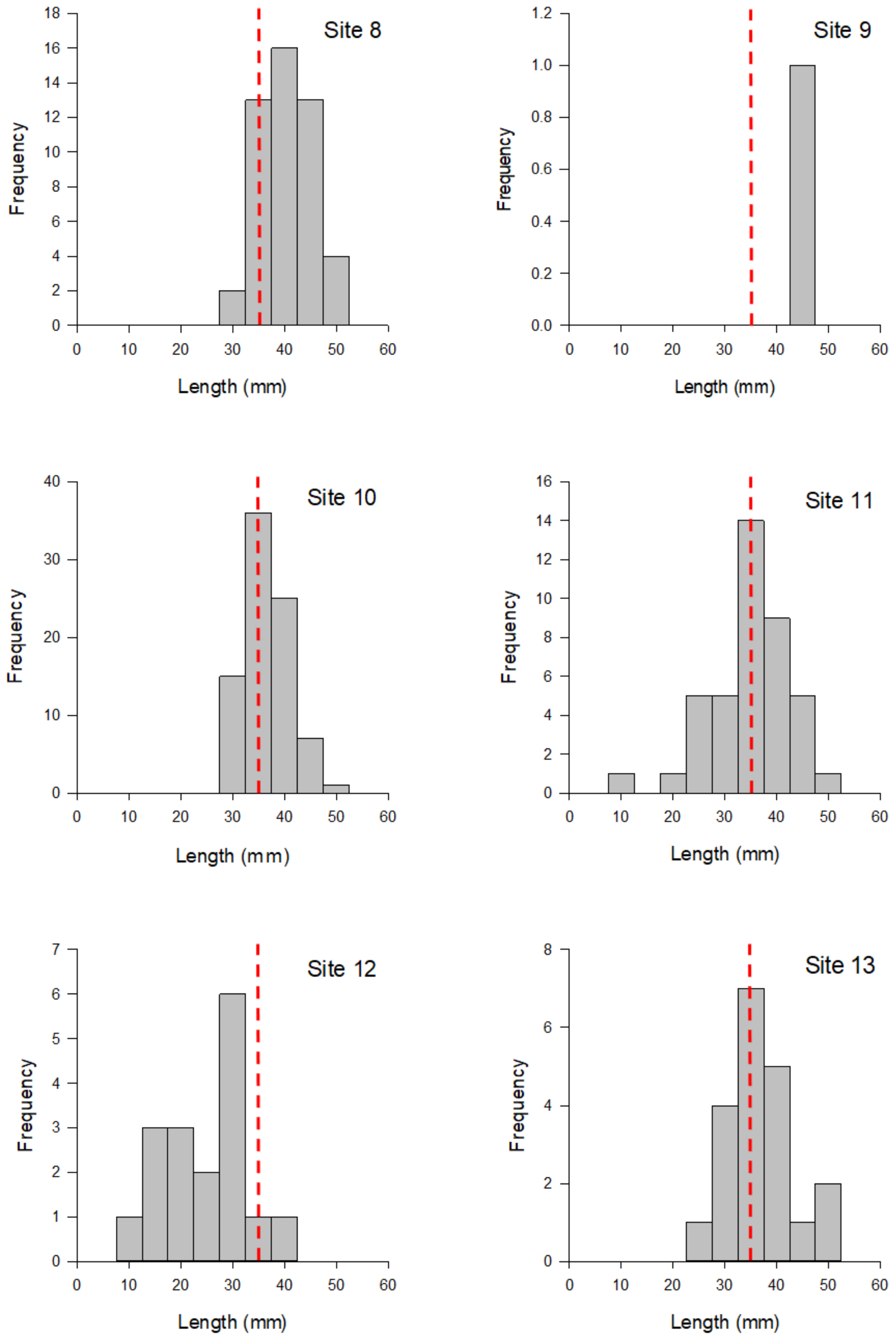


Figure 3.1 cont.: Histograms of the length frequency of Manila clam for each site sampled. The red dashed line indicates the minimum size of 35mm.

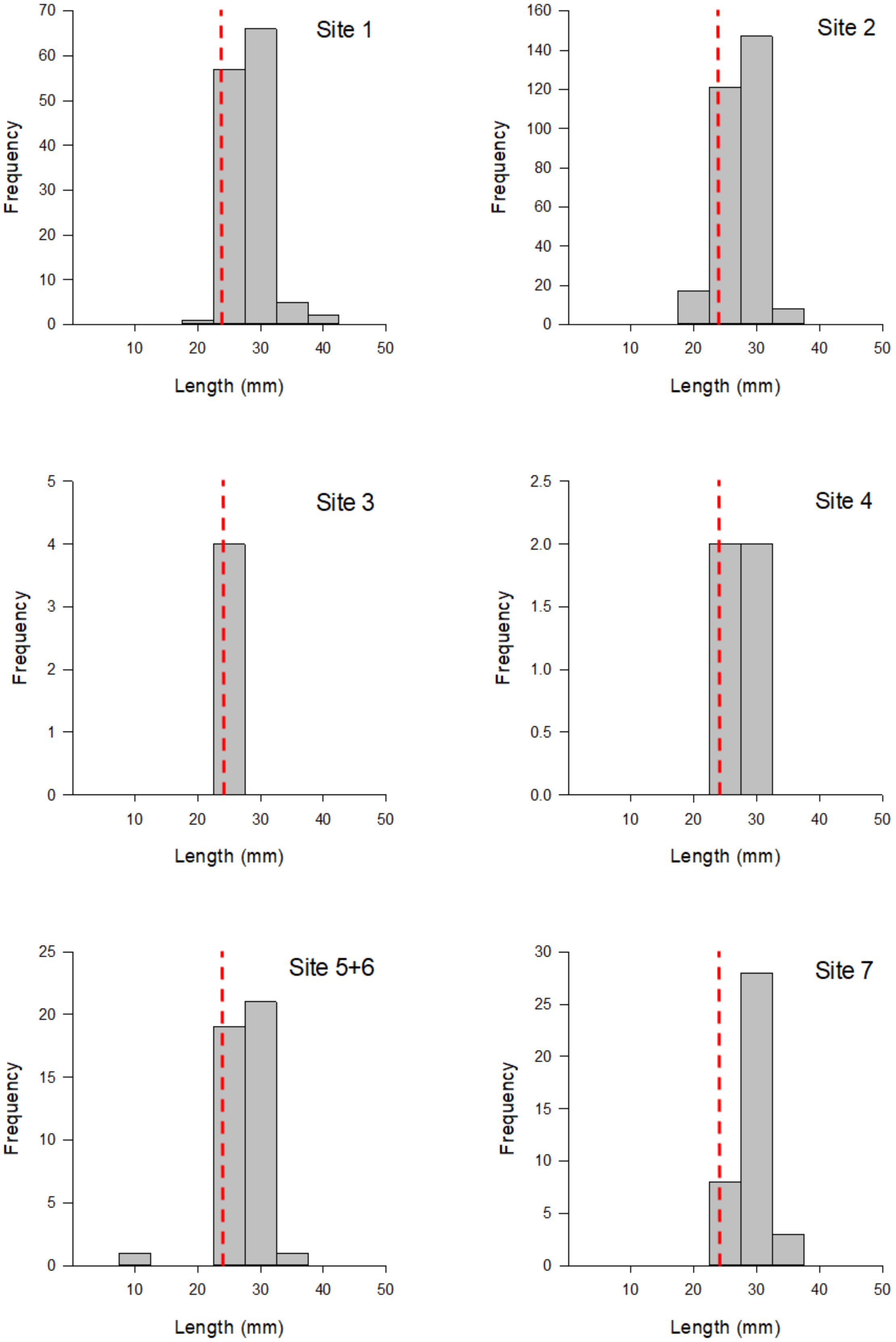


Figure 3.2.: Histograms of the length frequency of Common cockle for each site sampled. The red dashed line indicates the minimum size of 23.8mm.

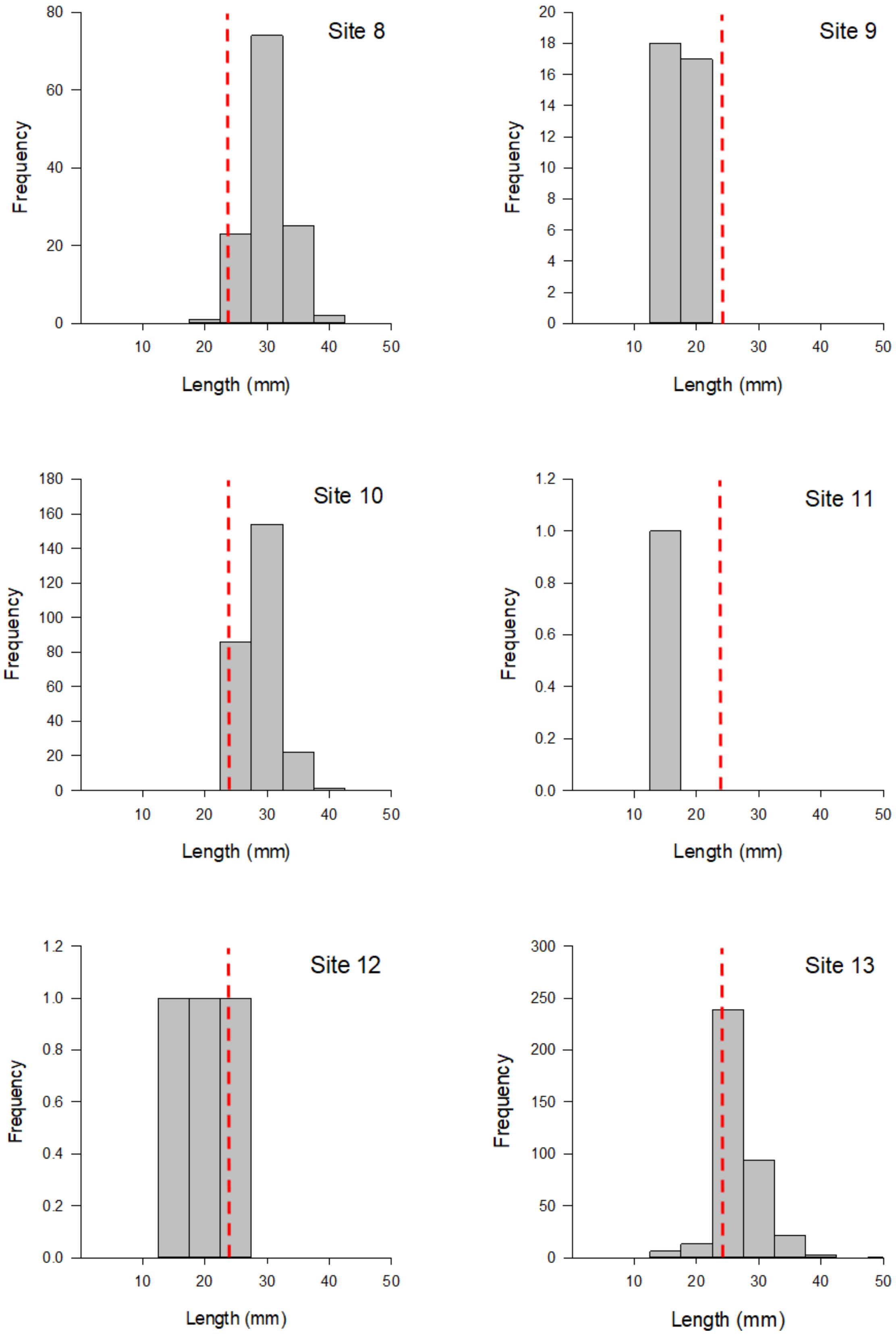


Figure 3.2 cont.: Histograms of the length frequency of Common cockle for each site sampled. The red dashed line indicates the minimum size of 23.8mm.

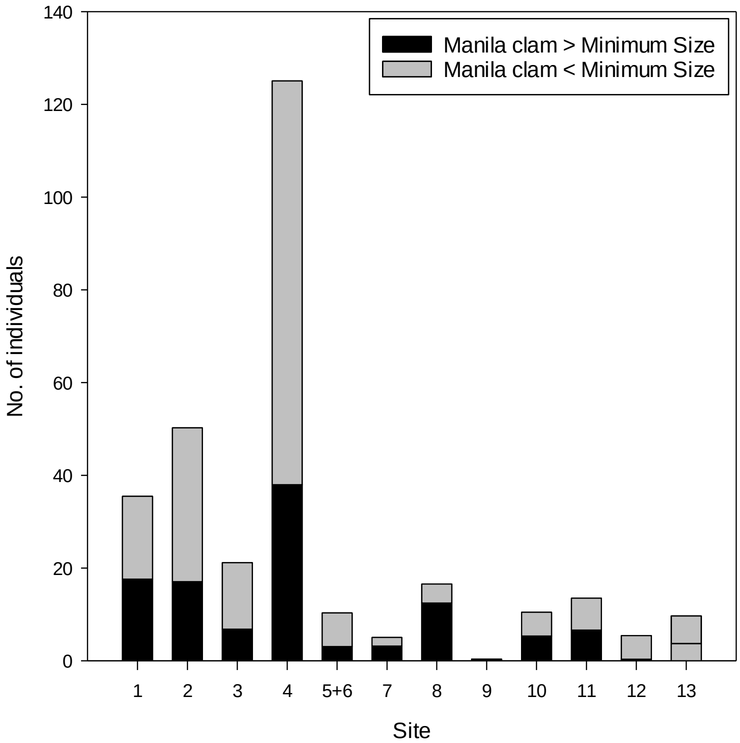


Figure 3.3: The number of individuals of Manila clam per average dredge tow length of 157m for each site sampled. The data shown is averaged over the three tows completed at each site. The data is split into Manila clam measuring over and under the minimum size of 35mm.

3.2 Number of Individuals per average tow

As outlined in section 2.1, an average length of a tow was determined as 157m and the number of individuals per average tow was calculated for each tow and then further averaged across the three tow to give a number of individuals per average tow length for each shellfish bed. The results are presented for Manila clam, Common cockle and American Hard-Shelled clam in figures 3.3-3.5.

The greatest number of Manila clam per average dredge tow length was seen at sites 1-4 with site 4 'Deans Lake' showing the greatest number at 125.1. The sites toward the northern end of Southampton Water and those on the Eastern side generally showed lower numbers of individuals. The pattern for the Common cockle and American Hard-Shelled clam is more varied. For Common cockle, sites 1, 2 and 13 showed the greatest number of individuals (46.9, 133.7 and 185.3 respectively). All of these sites are at the southern end of Southampton Water but cover both the western and eastern sides. For American Hard-Shelled clam, sites 1, 5+6 and 11 showed the greatest number of individuals, however numbers are generally much lower than for the other two species (4.0, 7.6 and 4.6 respectively). The pattern for size classes follows the general pattern established by the length frequency data with a generally higher proportion of Manila clam and American Hard-Shelled clam under the minimum size and cockle showing more sites with a dominance of individuals above the minimum size.

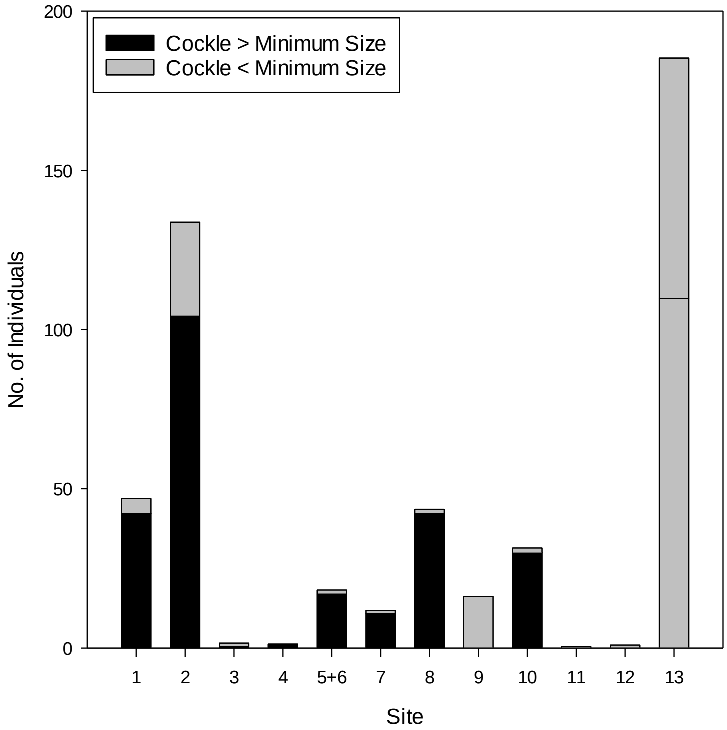


Figure 3.4: The number of individuals of Common cockle per average dredge tow length of 157m for each site sampled. The data shown is averaged over the three tows completed at each site. The data is split into cockle measuring over and under the minimum size of 23.8mm.

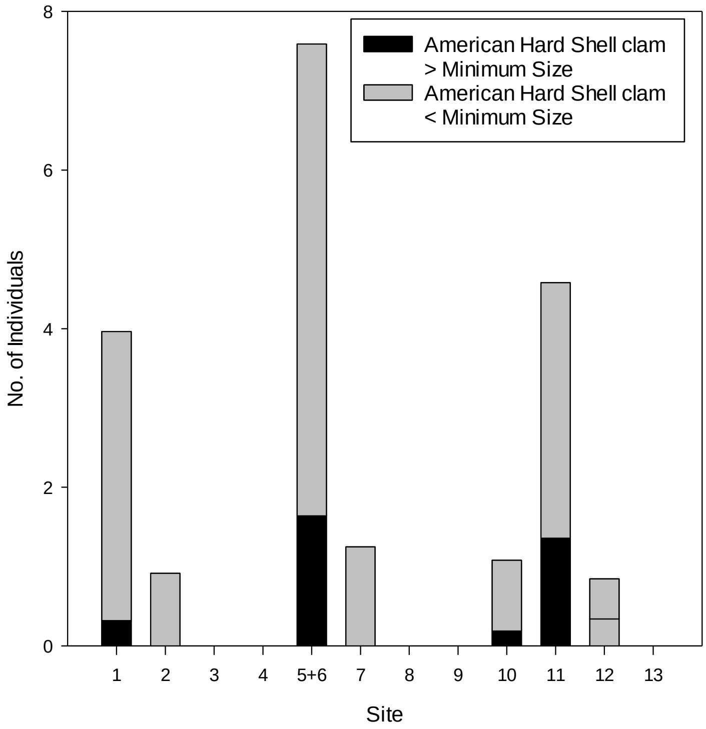


Figure 3.5: The number of individuals of American Hard-Shelled clam per average dredge tow length of 157m for each site sampled. The data shown is averaged over the three tows completed at each site. The data is split into American Hard-Shell clam measuring over and under the minimum size of 63mm.

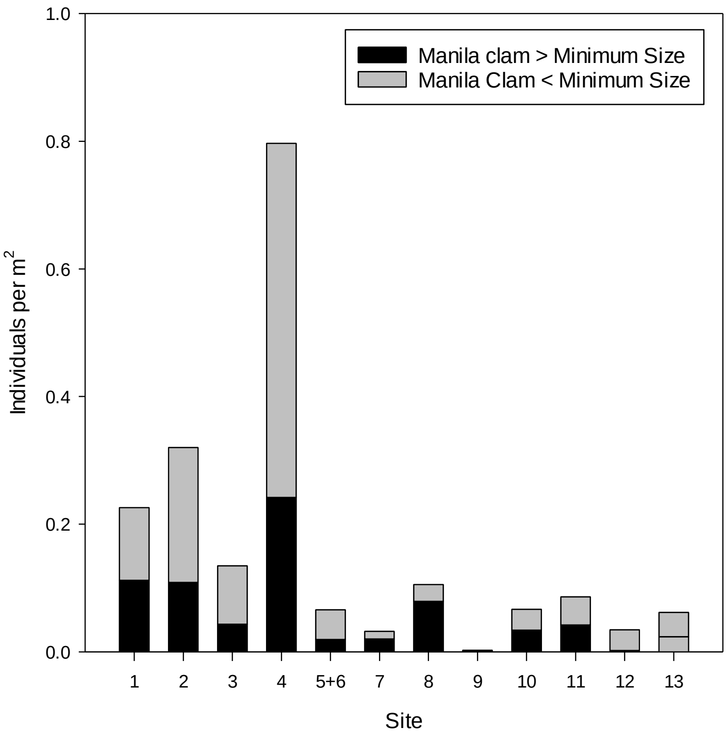


Figure 3.6: The number of individuals of Manila clam per m^2 of sediment for each site sampled. The data shown is averaged over the three tows completed at each site. The data is split into Manila clam measuring over and under the minimum size of 35mm.

3.3 Number of Individuals per m^2

The number of individuals per m^2 of seabed was also calculated for each of the three species, the average number of individuals per m^2 of seabed for each species for each site is show in figure 3.6-3.8.

For all of the species analysed, only cockle at site 13 'Hook Sands' showed a density of more than 1 individual per m^2. For all sites, Manila clam density varied between 0.797m^{-2} at site 4 'Deans Lake' and 0.002m^{-2} at site 9 'Ocean Village (River Itchen 2)'. At site 4, where the highest density was seen, there was a dominance of individuals under the minimum size of 35mm with 0.555m^{-2} compared to those above the minimum size with a density of 0.242m^{-2}.

For Common cockle, density varied between 1.180m^{-2} at site 13 'Hook Sands' and 0.003m^{-2} at site 11 'Netley'. As seen in the data generally, there is a dominance of individuals above the minimum size, at site 13 there was a density of 0.700m^{-2} of cockle above the minimum size compared to 0.481m^{-2} under the minimum size.

For American Hard-Shelled clam, the highest density was seen at site 5+6 'Hythe and The Gymp' at 0.048m^{-2}, for five out of the sites (3,4,8,9 and 13) there was a density of 0. For this species, there is a general dominance of individuals under the minimum size, at site 5+6 there was a density of 0.038m^{-2} below the minimum size compared to 0.010m^{-2} above the minimum size.

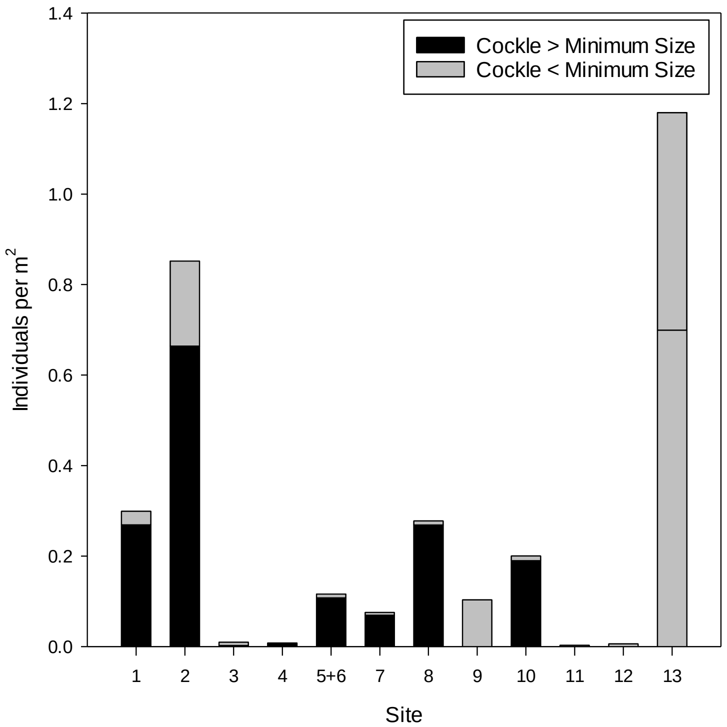


Figure 3.7: The number of individuals of Common cockle per m^2 of sediment for each site sampled. The data shown is averaged over the three tows completed at each site. The data is split into Common cockle measuring over and under the minimum size of 23.8mm.

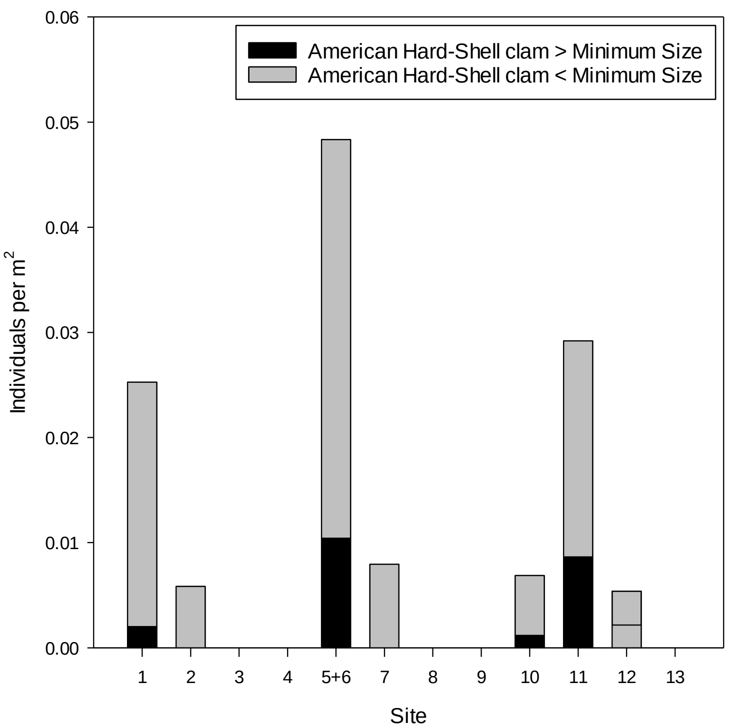


Figure 3.8: The number of individuals of American Hard-Shelled clam per m^2 of sediment for each site sampled. The data shown is averaged over the three tows completed at each site. The data is split into American Hard-Shelled clam measuring over and under the minimum size of 63mm.

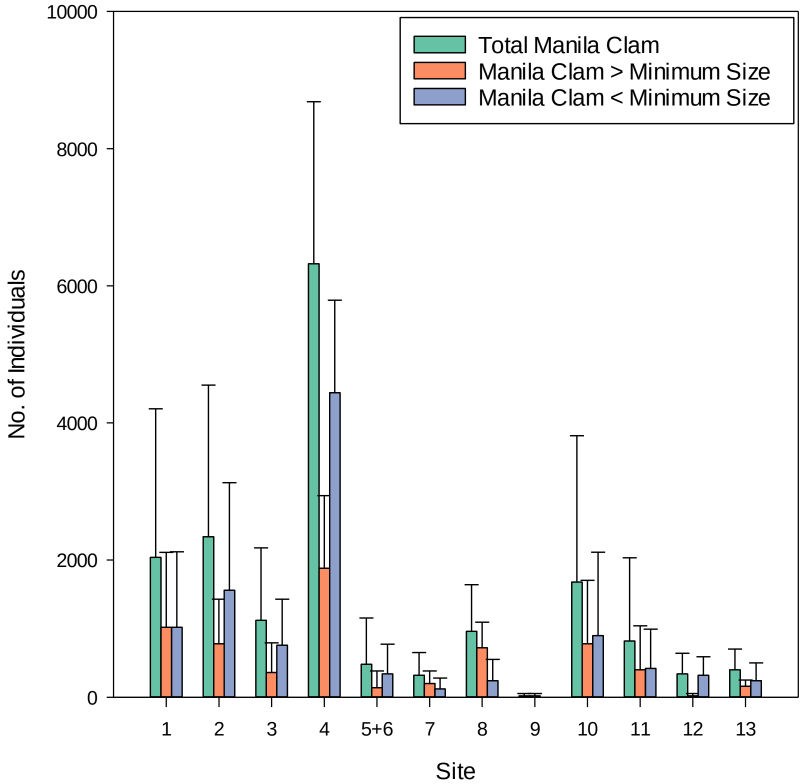


Figure 3.9: Average number of Manila clam per meter of dredge per hour for each site. The graph shows total number of Manila clam and Manila clam over and under the minimum size of 35mm. The error bars refer to the standard deviation.

3.4 Number of Individuals per meter of dredge per hour

As outlined in section 2.1, the number of individuals of each species taken for each tow was also scaled up to look at the number of individuals taken per meter of dredge per hour to give an estimate of the effort level of the fishery through an indication of catch per unit effort (CPUE) as the number of individuals of a particular species per hour based on the size of the dredge used. The results are shown in Figures 3.9-3.11.

Each species was split into the total number of individuals, those above and those below the minimum size. The results showed that for Manila clam, the highest average number of individuals per hour was 6320 at site 4 'Deans Lake' and the lowest was 20 at site 9 'Ocean Village (River Itchen 2)'. For site 4 there is a dominance of Manila clam below the minimum size with 4440 individuals. Although site 9 suggests a dominance of undersized individuals would be caught in an hour, this is based on scaling up data from a single clam so the result should be treated with caution.

For Common cockle, the greatest number of individuals retained in an hour is a site 13 'Hook Sands' with 7520 individuals. The lowest number is seen at site 11 'Netley' with 20 individuals. For site 13 there is a dominance of individuals above the minimum size with 4540 individuals. Again, when looking at site 11, although the data shows that all of the individuals caught within an hour would be below the minimum size this

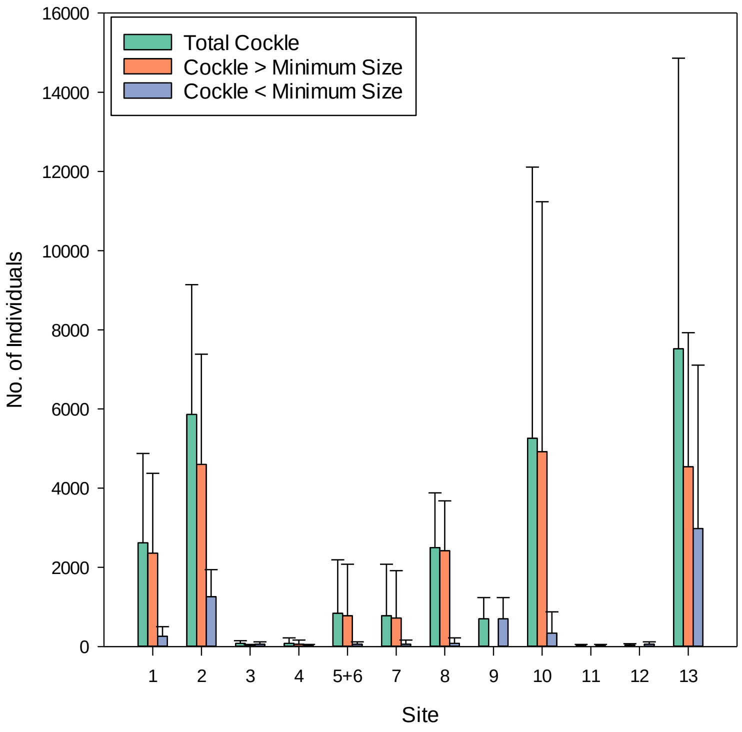


Figure 3.10: Average number of Common cockle per meter of dredge per hour for each site. The graph shows total number of Common cockle and Common cockle over and under the minimum size of 23.8mm. The error bars refer to the standard deviation.

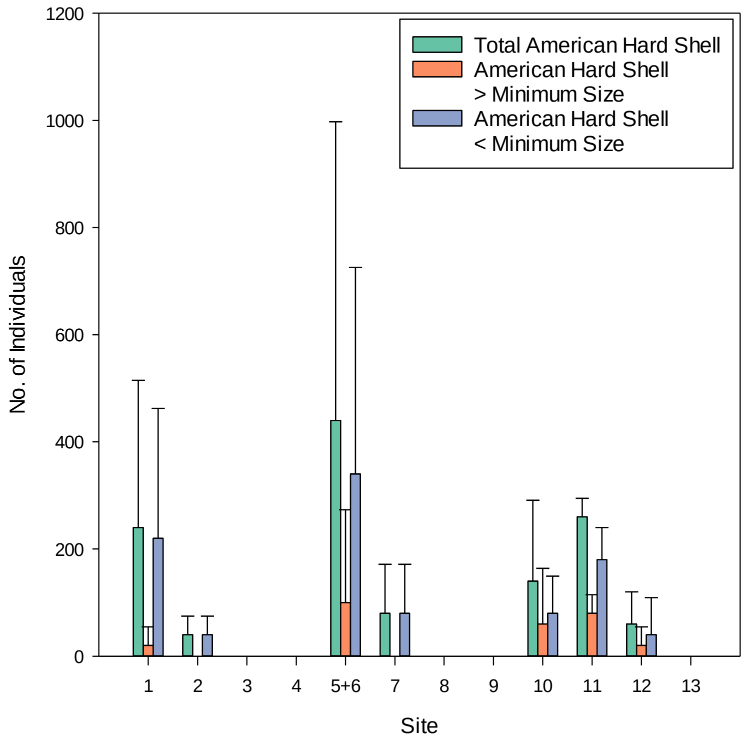


Figure 3.11: Average number of American Hard-Shelled Clam per meter of dredge per hour for each site. The graph shows total number of American Hard-Shelled Clam and American Hard-Shell Clam over and under the minimum size of 63mm. The error bars refer to the standard deviation.

is again based on the finding of a single cockle at this site and this should be taken into account when considering the results.

For American Hard-Shelled clam, site 5+6 ‘Hythe and The Gymp’ showed the greatest count of 440 individuals with a dominance of individuals under the minimum size at a count of 340. There are five sites where no individuals were found, excluding these, the lowest count per hour was seen at site 2 ‘Fuel Jetty’ with 20 individuals per hour, again as above, the dominance of individuals under minimum size seen at this site must be considered in conjunction with the fact that only two American Hard-Shelled clams were found at this site.

4. Discussion and Conclusions

This was the first survey of bivalve populations carried out in Southampton Water by the Southern IFCA. The aim is to continue to repeat the methodology outlined in this report on an annual basis to build up a time series dataset on the populations of the main commercial species in Southampton Water and to determine trends and patterns of abundance and density between the different areas sampled and between years.

As this is the first time this survey has been carried out it is difficult to make comparisons with the data. This survey has created a baseline of data against which future survey results can be compared. It is important to note that the data presented here is likely to be an underrepresentation of the abundance of bivalve species on the seabed in Southampton Water. The data presented here is assuming that the box clam dredge used is operating at 100% efficiency, which is unlikely to be the case. There is currently no data available on the efficiency of a box clam dredge, although the majority of dredges are similar in design and construction therefore if estimates on efficiency could be made it is likely that these would be similar across the majority of the fishery. Similar work on dredge efficiency has been carried out for oyster dredges indicating that, depending on design, they can be between 2-35% efficient (Cooper, per comm.). This work could be further developed by looking at determining the efficiency of a box clam dredge and relating this to the results seen.

In general, the data from this survey shows that the Common cockle (*Cerastoderma edule*) appears to be the dominant bivalve found in the dredges undertaken. The abundance varies between the different sites and with increased abundance in the beds at the southern end of Southampton Water on both the eastern and western sides. Individuals were also recorded at the far northern end of Southampton water, in sites in the Itchen River, which may be explained by the ability of the Common cockle to tolerate low salinities. The Common cockle is not currently harvested to the extent of the Manila clam (*Ruditapes philippinarum*) and American Hard-Shelled clam (*Mercenaria mercenaria*) in Southampton Water, however there is currently no classification data for the Common cockle therefore classification of areas would be required before commercial harvesting could occur.

The distribution of Manila clam indicates that there is a greater density of the population in beds on the western side of Southampton Water toward the southern end, focusing on areas from Ashlett Creek to Deans Lake. These areas fall within the classified areas for Manila clam although vary between a B and C class. All these areas are those that are most routinely used by the clam dredge fishery, although as you move north into the area of Bird Pile and Deans Lake these areas have only been open since autumn 2016 when the classification was changed from prohibited to a C class. The closure of the Deans Lake area up until autumn 2016 may explain why the highest abundance and density of Manila clam was found in this area as it has been subject to fishing pressure for a shorter length of time than the more southerly sites. However, it would be expected that the areas which are still prohibited to fishing at the northern end of Southampton Water would show a greater abundance of Manila clam as they have not been fished for a number of years however this is not the pattern that is being seen from this survey. In the areas where abundance of Manila clam is higher there is also a dominance in the population of individuals under the minimum size. This could be explained by the higher fishing pressure in this area which is removing the individuals at or above the minimum size of 35mm creating a skew in the size distributions at these sites. However, the general pattern appears to show a dominance of undersized Manila clam at a number of sites which are not subject to fishing pressure therefore the pattern seen cannot be attributed to fishing activity alone.

Looking at the results for the American Hard-Shelled clam, it is difficult to determine a reliable pattern as so few individuals were found. The area at Hythe which showed the highest abundance and density could be explained by virtue of the fact that this are is currently prohibited to harvesting and has been for a number of years therefore the population is not subject to fishing pressure. However, this pattern is not seen in other areas which are prohibited to harvesting and therefore this cannot be the only controlling factor for the pattern seen.

In order to have a better understanding of what factors may be contributing to the patterns seen for the bivalve species surveyed, there is a need to analyse other data sources and habitat data for Southampton Water to determine whether factors such as habitat type, hydrology, or other activities are having an effect on the distribution of these species. In terms of using this data to inform future management of the fishery, as a time series dataset is built up it will be easier to ascertain if there are any changes occurring within the distribution, abundance and density of these species which may require management intervention. While this survey provides a good first step in creating a baseline for this fishery, there is a need for further elucidation on the factors controlling the patterns seen and the need to be able to compare data between years to ensure that management measures are robust and appropriate for the fishery.

5. References

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