Taw-Torridge Mussel Baseline Monitoring for Re-laying Trial 2021–22

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Contents

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Lauren Henly	12/2021	Draft report	0.1
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1. Introduction

1.1 The Taw-Torridge Estuary

The Taw-Torridge Estuary is located on the North Devon coast, within the Area of Outstanding Natural Beauty (AONB) and the North Devon UNESCO Biosphere Reserve (Figure 1).

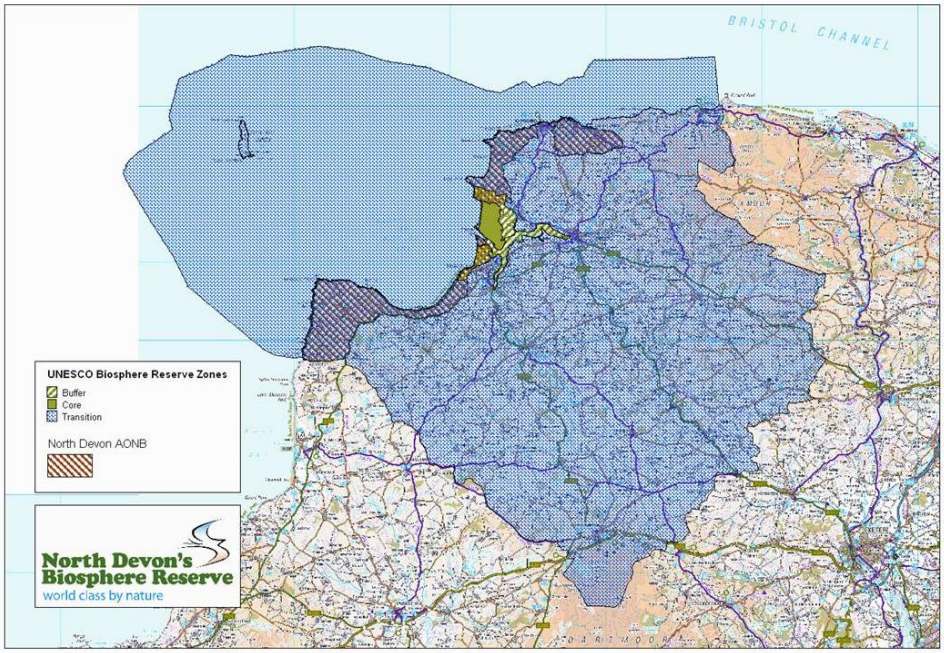


Figure 1 The location of the Taw Torridge Estuary (shown in yellow) within the North Devon Biosphere Reserve and the North Devon Coast AONB. (North Devon AONB and Biosphere Reserve Service, 2010)

The Taw Torridge Estuary is an important site for wildlife and has been designated a Site of Special Scientific Interest (SSSI) (Figure 2) for over-wintering and migratory populations of wading birds, and for the rare plants found on its shores. Parts of Taw-Torridge Estuary lie within the Braunton Burrows Special Area of Conservation and the Bideford to Foreland Point MCZ also crosses the mouth of the estuary, shown in Figure 3.

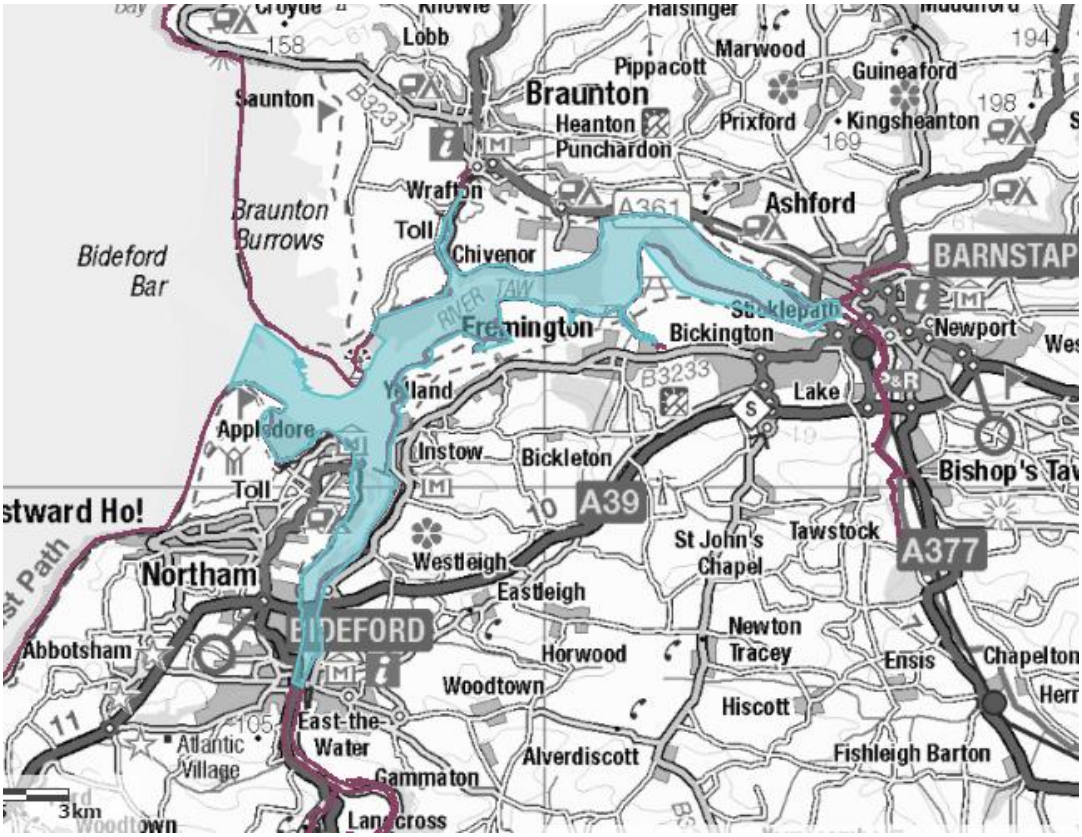
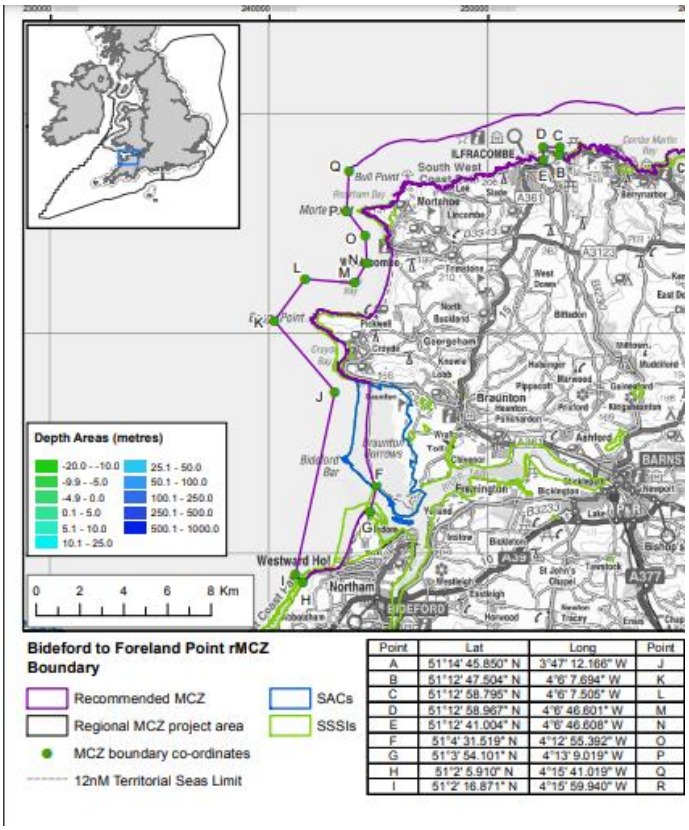


Figure 2 Taw-Torridge Estuary SSSI, shown in blue (Defra, 2020)



Point	Lat	Long	Point
A	51°14' 45.850" N	3°47' 12.166" W	J
B	51°12' 47.504" N	4°6' 7.694" W	K
C	51°12' 58.795" N	4°6' 7.505" W	L
D	51°12' 58.967" N	4°6' 46.601" W	M
E	51°12' 41.004" N	4°6' 46.608" W	N
F	51°4' 31.519" N	4°12' 55.392" W	O
G	51°3' 54.101" N	4°13' 9.019" W	P
H	51°2' 5.910" N	4°15' 41.019" W	Q
I	51°2' 16.871" N	4°15' 59.940" W	R

Figure 3 Area of Bideford to Foreland Point MCZ shown by purple outline, area of Taw-Torridge Estuary SSSI shown by green outline, and area of Braunton Burrows SAC shown by blue outline.

1.2 *Mytilus edulis*

Blue mussels, *Mytilus edulis*, are cold-water mussels which can occur in brackish water (Gardner, 1996). They are found on the north Atlantic and north Pacific coast of North America, Europe and in other temperate and polar waters. Blue mussels can occur intertidally and sub-tidally, and on a variety of substrates, from rocks to sediments, and in a range of conditions. “Blue mussel beds on sediment” are listed as a Section 41 Habitat of Principal Importance (JNCC, 2011). This includes a range of sediments, such as sand, cobbles, pebbles, muddy sand and mud. The ability of *M. edulis* to occupy such a range of habitats results from its ability to withstand wide variation in salinity, desiccation, temperature and oxygen concentration (Bayne and Worrall, 1980; Seed and Suchanek, 1992; Andrews *et al.*, 2011).

M. edulis beds play an important role in the healthy functioning of marine ecosystems; having a role in coastal sediment dynamics, acting as a food source to wading birds, and providing an enhanced area of biodiversity in an otherwise sediment-dominated environment (JNCC, 2011). Mussel beds support their own diverse communities as the mussel matrix, composed of interconnected mussels and accumulated sediments and debris, provides numerous microhabitats and an organically enriched environment (Seed and Suchanek, 1992; Andrews *et al.*, 2011). Blue mussels are filter feeders, feeding primarily on micro-algae, suspended debris and zooplankton, and play a vital role in estuaries by removing bacteria and toxins.

The reproductive strategy of *M. edulis* is to deploy a large number of gametes, approximately three million eggs, into the surrounding water where fertilisation takes place (Andrews *et al.*, 2011). Following fertilisation the zygotes, as planktonic larvae, undergo six stages of metamorphosis before settlement. Mussels can adapt their reproductive strategy depending on environmental conditions. For example, the release of gametes can be timed to complement favourable environmental conditions, and the planktonic phase can last between two and four weeks depending on temperature, food supply and availability of a suitable substrate to settle on (Andrews *et al.*, 2011). Depending on temperature and nutrient levels, spawning may occur just once or several times per year (Bayne and Worrall, 1980; Seed and Suchanek, 1992; Handå *et al.*, 2011).

Current threats to *M. edulis* beds include commercial fishing, water quality, coastal developments, anchoring, bait digging, and intensive recreational hand gathering (JNCC, 2011).

1.3. Objectives

D&S IFCA is currently looking at how it can better manage the shellfisheries on the Taw-Torridge Estuary and proposed a trial project to Natural England to begin that process. D&S IFCA obtained assent from Natural England to dredge subtidal mussel from the Taw-Torridge Estuary (outside of the SSSI), which will be re-laid in intertidal areas further upstream. The subtidal mussel resource, which is not part of the SSSI, is thought to be at risk of being entirely removed from the system by winter storms and/or high riverine flow during winter 2021/22. The trial will move a small quantity of this mussel to less-vulnerable intertidal areas.

This project is a follow-on from the 2021 intertidal and subtidal surveys and this report will set a baseline for future monitoring of the mussel relaying locations following the trial.

2. Methodology

2.1 Survey Methodology

A survey of the proposed relaying areas (Figure 4) was conducted on 19th November 2021. The survey areas (on part of the Coolstone mussel bed and adjacent to the Yelland bed) are intertidal and accessible on foot from land. The survey took place during spring tides to ensure the full extent of the mussel beds were accessible.

Due to the varying levels of patchiness and density, the area surveyed cannot always be indicative of the size of a true mussel 'bed' and is rather a representation of the area in which live mussels were located. This means that the survey area will not always be purely on mussel bed, but also on areas where mussels occur in small, dispersed patches. The perimeters of the survey areas were determined by using the start and end coordinates of each of the transects, recorded using a handheld GPS (Figure 4).

To determine coverage and patch density, transects were walked in a zig-zag pattern across the survey area (Figure 4), up to the extent of the proposed relaying area or to the water's edge. The start and end coordinates of each transect were recorded using a handheld GPS. A 4 ft bamboo cane with an 11cm ring attached to the end, arranged so that the ring sits flat on the ground when held out to one side, was used to determine the mussel coverage for each transect: every three paces (one pace consisting of a single step) along each transect the cane was placed out to one side and the presence or absence of live mussels within the ring were recorded. On every fifth hit (presence) the contents of the ring were taken as a sample, using an 11cm diameter corer. All mussel samples from the same transect were collected together in one bag and kept separate from those of other transects. This methodology is known as the 'Dutch Wand Method'.

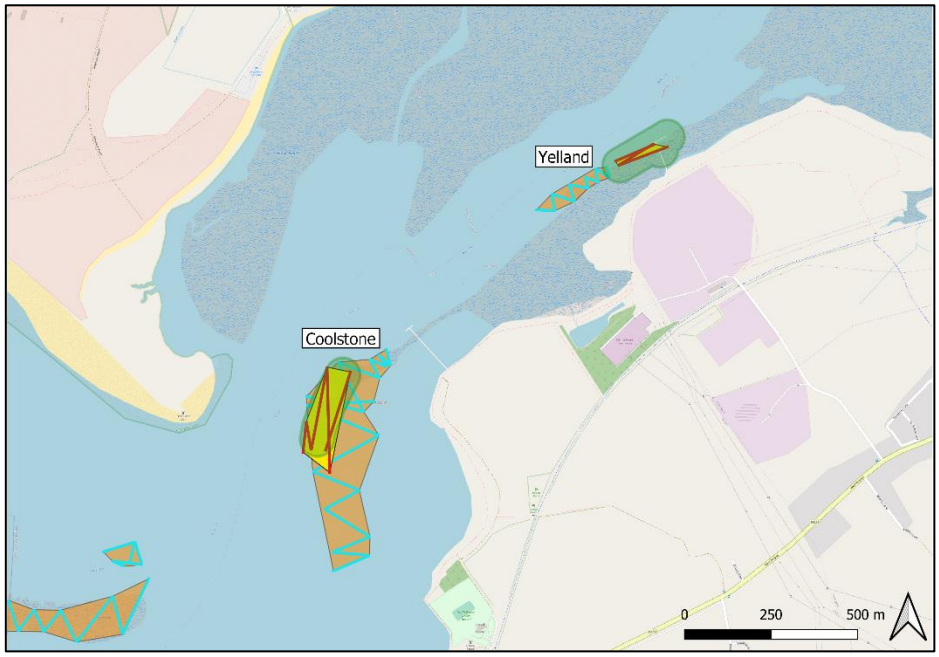


Figure 4 Area of each mussel bed surveyed (yellow) and paths of transects walked (red). Green polygons represent the proposed relaying locations identified by the fisher and the orange polygons show the area of intertidal mussel beds surveyed in the annual intertidal mussel surveys in 2021.

Once all transects were complete the mussel samples were sieved and cleaned. For each transect the total number of samples taken was recorded, and all mussels were measured and divided into the following size groups; 1-10mm, 11-20mm, 21-30mm, 31-40mm, 41-50mm, 51-60mm, 61-70mm, 70+mm.

2.2 Data Analysis

The data collected from both the transects and samples were used to calculate the percentage cover (Equation 1), density (Equation 2) and area of the survey area (by generating a minimum convex polygon around the transect lines), which were then used to estimate the mussel tonnage on each site (

Equation ***3***). Total tonnage and survey area across each site was calculated based on the weight of mussels in the samples taken and scaled up by the density. As there is a Minimum Conservation Reference Size for mussels in the Taw-Torridge fishery of two inches (~51 mm), the tonnage of mussels available to be removed from the fishery (≥51mm) was also calculated for each site. Size distribution data were obtained from the length measurements of mussels in the retained samples.

Equation 1: Calculation of the percentage cover of mussel

$$\%\ \boldsymbol{cover} = \frac{no.hits}{no.hits + no.misses}$$

Equation 2: Calculation of the density of mussel cover

$$\boldsymbol{Density}\ (\boldsymbol{kg/m^2}) = \frac{total\ mussel\ weight\ sampled}{surface\ area\ sampled} \times \%\ cover$$

Equation 3: Calculation of mussel tonnage

$$\boldsymbol{Tonnage\ of\ mussel} = \frac{Density\ \times 10{,}000\ \times Area(ha)}{1000}$$

3. Results

3.1 Coolstone re-laying area

Thirty one samples were collected from 5 transects in the Coolstone survey area. The survey area totalled 2.4 ha and the total mussel density within the survey area was 4.82 kg/m^2. Mussels covered 56.16% of the survey area and the total tonnage in the survey area was calculated to be 114 tonnes. The mussels collected in the samples varied in size, but the majority were >30 mm (Figure 5). Thirty four tonnes out of the 114 tonnes were over the Minimum Conservation Reference Size for the Taw-Torridge.

The density, percentage cover and tonnage of mussels in the proposed re-laying area of the Coolstone bed were all greater than when compared to the values estimated for the whole Coolstone bed (approximately 9.1 ha), which was surveyed earlier in 2021. Over the whole Coolstone bed, the density of mussels was 1.16 kg/m^2, the percentage cover was 22.29%, and the total calculated tonnage was 105 tonnes.

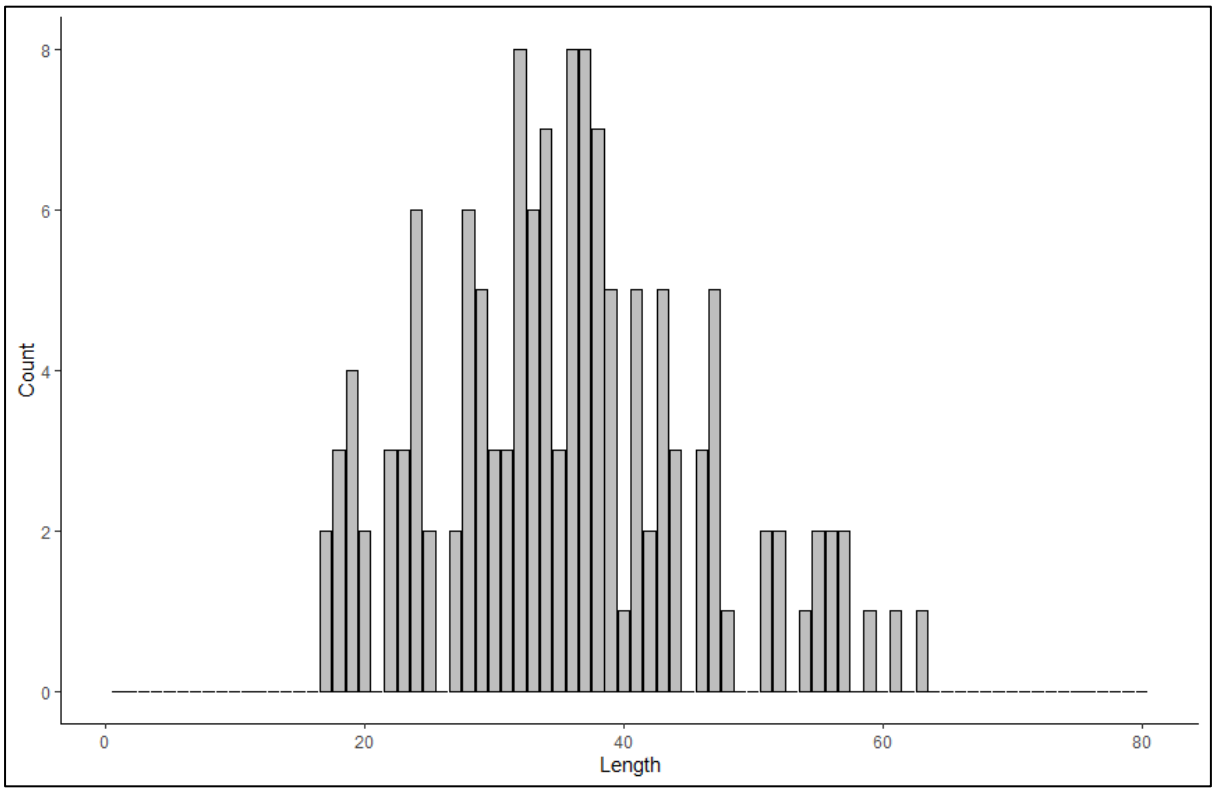


Figure 5 *Size of mussels sampled from the proposed Coolstone re-laying area*

3.2 Yelland re-laying area

Four samples were collected from a total of three transects in the survey area adjacent to the Yelland bed. Mussels were only collected from the first transect as not enough mussels were 'hit' on the other two transects. The survey area totalled 0.3 ha and the total mussel density within the survey area was 3.31 kg/m^2. Mussels covered 17% of the survey area and the total tonnage in the survey area was calculated to be 9 tonnes. Most mussels collected in the samples from the Yelland transect were in the 41–50 mm size class or above and 8 of the 9 tonnes were over the Minimum Conservation Reference Size for the Taw-Torridge (Figure 6).

The density, percentage cover and tonnage of mussels in the proposed re-laying area adjacent to the Yelland bed were all lower than that of the whole Yelland bed (approximately 0.8 ha), which was surveyed earlier in 2021. Over the Yelland mussel bed, the density of mussels was 6.96 kg/m^2, the percentage cover was 48%, and the total calculated tonnage was 57 tonnes.

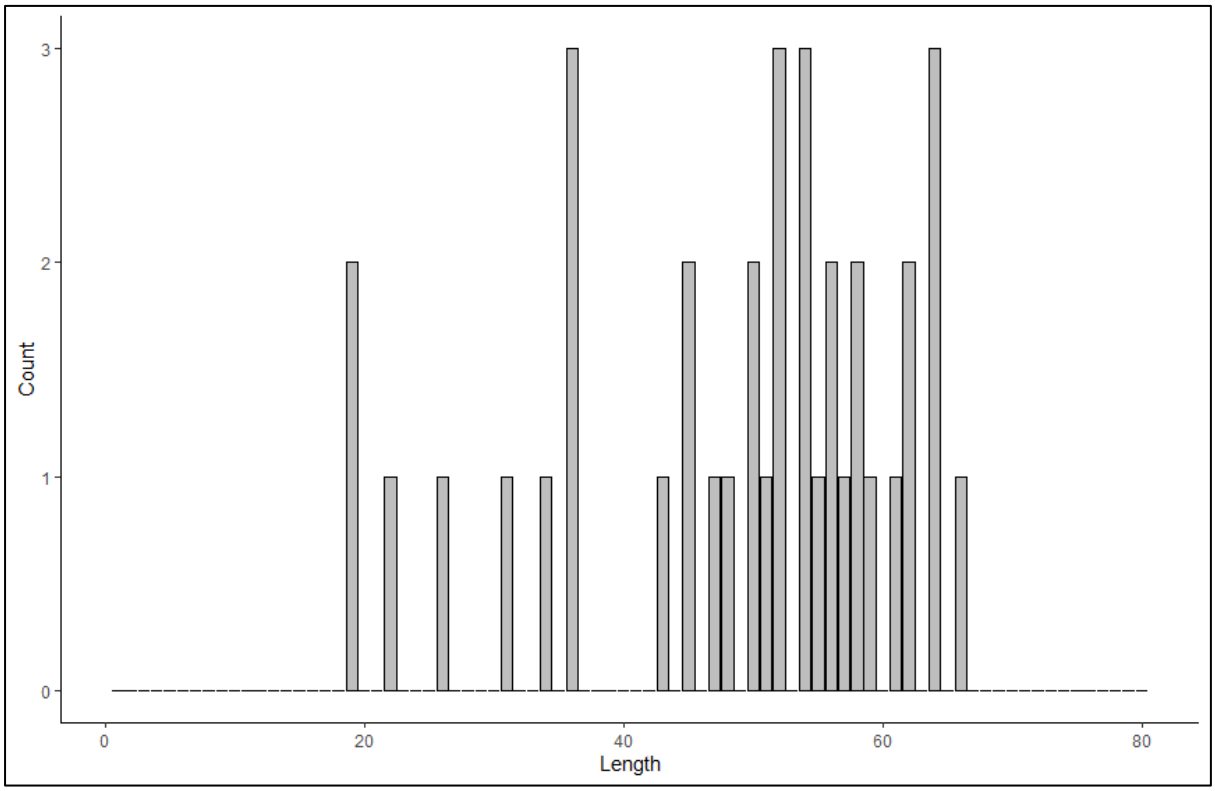


Figure 6 *Size of mussels sampled from the proposed re-laying area near the Yelland Mussel bed.*

4. Discussion

4.1 Comparison of proposed re-laying sites with previously surveyed beds

There were differences in density and tonnage of both proposed mussel-relaying areas and their respective overlapping/adjacent whole mussel beds. It was surprising that the total estimated tonnage of mussel in the Coolstone re-laying area was greater than the tonnage estimated for the whole Coolstone bed surveyed earlier in the year. The majority of the Coolstone relaying area overlaps with the previously surveyed whole mussel bed, so it is clear there are some inaccuracies in the estimates made for both areas. Mussel density is not uniform across the whole Coolstone bed. The overall density of mussels in the re-laying area was calculated to be higher than that for the bed as a whole so it is unsurprising that concentrating survey effort to this small section of the Coolstone bed resulted in a comparatively high tonnage estimate. When the tracks of the transects walked in each survey are mapped (Figure 7), there seems to be very little coverage of the dense relaying area in the earlier survey of the whole Coolstone bed. The angles between transects walked by the officers carrying out the survey of the whole bed were also wider than those walked in the re-laying area and the overall direction of the surveys were different (the transects of the whole bed followed landward-seaward-landward pattern, whereas the transects of the relaying area went from downstream-upstream-downstream, moving seaward as the tide fell). During the earlier survey of the entire Coolstone bed, the wide angles resulted in only a very small portion of the re-laying area being crossed and the different directions of transects may have exacerbated the under-estimate of the density across the whole bed as there are often gullies containing very few mussels running from landward to seaward.

A direct comparison between the Yelland mussel bed and the adjacent re-laying area is less easy to make as there is no overlap between the two areas. Only the first transect of the Yelland re-laying area contained mussels; the landward areas were predominantly mud interspersed with small areas of harder substrate. In contrast, all but one of the ten transects of the Yelland mussel bed surveyed earlier in the year contained mussels. The direction of transects differed between the Yelland bed and re-laying area (as was seen on the Coolstone bed), so this could have contributed to the difference in proportion of transects that contained mussels, although locations landward of the Yelland mussel bed contain more rocky substrate than in the proposed relaying area, which could contribute to the greater density of mussels.

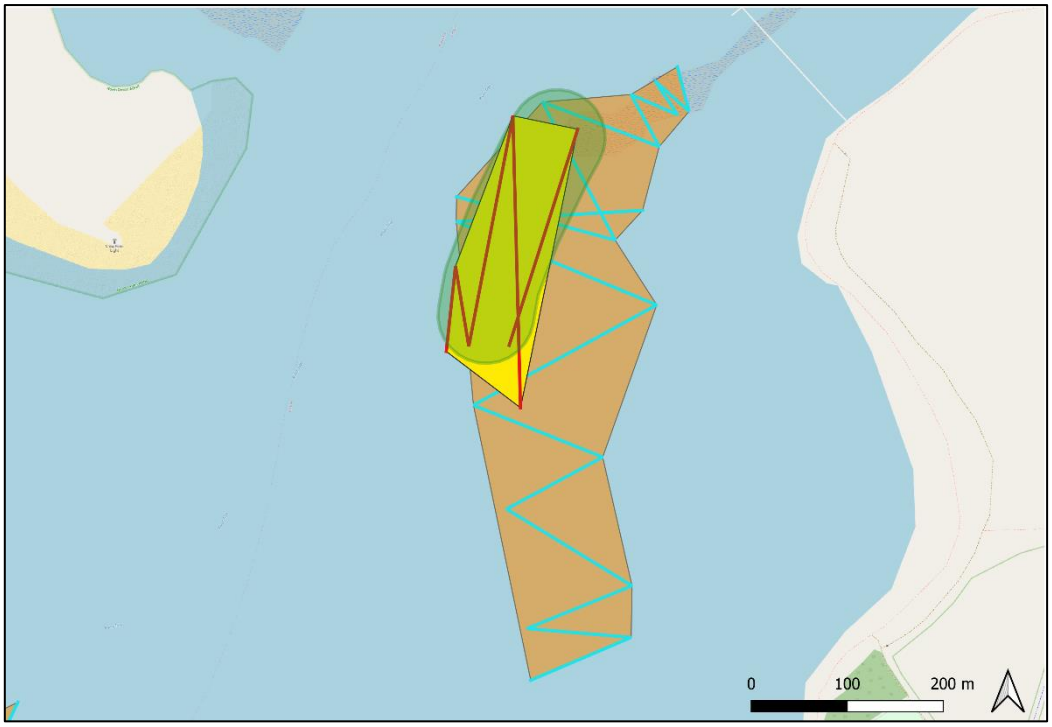


Figure 7 *Paths of transects walked over the proposed re-laying area on the Coolstone mussel bed (red lines) and over the whole Coolstone bed (blue lines), which was surveyed earlier in 2021.*

4.2 Suitability of the areas for re-laying

The mussels will be re-laid at a density which is known to allow attachment of the new mussels onto the existing mussels bed or hard substrate (R. Jessop, EIFCA pers. comm.). Whilst re-laying too densely may result in smothering or changes to the natural size structure of the mussel bed, the small scale of this trial is unlikely to have a negative impact on nearby beds. Furthermore, the target areas contain suitable substrate for mussel establishment (e.g. some existing mussel, hard substrates such as rocks, interspersed with small areas of sand).

The mussel density and percentage cover in the whole Coolstone intertidal bed is low relative to recent years and relative to other nearby intertidal mussel beds (Henly, 2021); re-laying mussels on this bed may therefore promote recovery of natural mussel beds. However, the proposed re-laying area on the Coolstone bed seems to be more densely covered with mussels than the overall bed. This dense mussel area may therefore be at risk of being smothered if a large amount of mussel is re-laid in this location. The percentage cover of mussels in the proposed re-laying area is ~56%, which suggests that although the density of mussels is high, it is likely to be patchy. The fisher that will carry out the re-laying work plans to use buoys to mark the patches of the re-laying site that have less mussel coverage, allowing these areas to be targeted during the re-laying. This will reduce the risk of smothering areas with denser mussel coverage. If the re-laid mussels take hold in this area it has the potential to benefit the overall density of the whole Coolstone bed.

The sparse mussel coverage and lack of hard substrates in areas seaward of the Yelland Quay jetty may reduce the suitability of the habitat for mussel attachment. In the past the area around the Yelland Quay Jetty legs has been a productive area for mussel growth and harvesting (fisher, pers. comm.). Most of the mussel will be relaid in the areas between the legs of the jetty, which were not able to be surveyed effectively using the Dutch Wand Method (instead the survey focussed on the areas either side – landward and seaward – of the jetty legs). The first transect in the Yelland re-laying area (the only transect that contained mussels) followed the outer margin of the seaward jetty legs. There were dense patches of mussels covering the base of the jetty legs (Figure 8), and the areas between the legs, where the mussels will be re-laid, were a mixture of hard substrate, such as rocks, interspersed with sand and smaller patches of mussels: suitable substrate for mussel attachment. As a result, re-laying mussels in these areas may help promote recovery of natural mussel beds, and the lower wave action experienced in this location will help to ensure the newly laid mussels do not wash away.

A previous pilot trial of this method on the Taw-Torridge appears to have been successful: anecdotal information and a recent survey suggests that the mussels re-laid at the Oil Jetty have successfully established. From the information gathered in this survey and report, there is no reason to believe that the planned re-laying of mussels in the proposed locations will not also be successful.

4.3 Next steps

Mussels will be dredged during a neap high tide. For re-laying over the Coolstone bed, the mussels will be re-laid immediately after removal by washing the mussels off the deck using the deck hose. The mussels will be washed out through the stern of the fishing vessel over the target areas, which will be pre-marked with buoys. For re-laying between the Yelland Quay Jetty legs, the mussel will be immediately transferred to crates for re-laying via a smaller tender vessel that is able to access this area. Re-laying will be carried out during the same tide. Future monitoring of the sites will inform an assessment of the success of the re-laying.

Figure 8: *Dense patches of mussels at the base of the jetty legs*

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