Seagrass Survey of Polruan Pool in Fowey Harbour

August – September 2020

Tevi

Growing Your Business,
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Tevi (Cornish for 'grow') is an EU-funded programme which aims to create both economic and environmental growth in Cornwall and the Isles of Scilly.

The initiative, which runs until 2022, provides small and medium-sized enterprises across the county with expert consultation, opportunities for recognition and certification, and grant funding. Our objective is to help enterprises make the most of the prized asset upon which they rely – our beautiful natural environment – by helping them grow their business.

We support enterprises to play a proactive role in growing and protecting the region's unique natural environment, while also becoming more efficient with their natural resource use and minimising their waste in smart and innovative ways, as part of the global transition towards a circular economy.

Tevi's Challenge Networks bring organisations together to collectively identify, and bring to market, solutions to environmental challenges that no one organisation can solve alone. Over the course of the three year programme Tevi will run a number of Challenge Networks, of which protecting seagrass through accelerating advanced moorings uptake, is one.

Tevi is led by the University of Exeter, and is delivered in partnership with the Cornwall Wildlife Trust, Cornwall Council and the Cornwall Development Company. Find out more about the programme at www.tevi.co.uk.

University of Exeter

Cornwall Wildlife Trust

Cornwall Council
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Cornwall Development Company

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1. Executive summary

Seagrass surveys were commissioned by Tevi in August and September 2020 to provide information on the extent and health of the seagrass beds within Polruan Pool in Fowey Harbour.

1.1 Approach

The extent and percentage cover of the seagrass bed were assessed by drop down/ towed video (DDV) on the 4th August 2020. Phase 2 diving surveys were undertaken on the 4th and 5th September 2020 according to the Code of Practice for Scientific and Archaeological diving projects.

To provide data on the health of the seagrass, the diving surveys assessed the following on three transects mapped during the DDV survey:

- number of shoots and % cover in each quadrat
- mean maximum length per shoot
- % cover by epiphytes
- putative infection by Labyrinthula zosterae

Additionally, the same metrics were assessed on transects radiating north, south, east and west from 3 moorings within the seagrass bed to make a preliminary assessment of the impact of these 3 existing block and chain moorings on the seagrass bed.

1.2 Findings

The seagrass bed was found to be considerably greater in extent than previously thought, covering an area of over 7.3 hectares which is over 2.5 times greater than that observed by the Environment Agency (E.A.) in 2019.

It is also an order of magnitude larger than the estimated size of the bed in 1996. Although the current study is by far the most comprehensive survey of the area to date and the methods vary considerably between surveys, it is likely that the extent of the seagrass has been increasing since 1996.

The mean percentage cover within the bed was moderately high varying from 50 to 65% between the transects which was consistent with the data from the DDV. However, the bed was patchy which is thought to be, in part, related to the very high density of moorings within Polruan Pool.

The % cover of macroalgae within the bed, the mean cover of leaves with epiphytes and the mean putative infection with Labyrinthula zosterae was low in all the transects and mooring dives that were undertaken. The mean maximum length of the leaves per shoot varied from 60 cm on Transect T2 to 87 cm on transect T1 with some leaves exceeding 140 cm. Taken together, these factors suggest that the seagrass is in good health. It is thought that the shorter mean maximum leaf length observed at transect T2 may be associated with the fact that the channel in which it was located is subject to a high amount of boat traffic from the Polruan ferry and others.

For two of the three moorings examined, there appeared to be a localised reduction in both the % cover and the number of shoots at stations which might extend up to 4m radiating from each mooring. Even though the data suggests that any effect is likely to be extremely localised, given the density of moorings in Polruan Pool any mitigation in this impact is likely to benefit the integrity and resilience of the bed. However, since one mooring was totally unaffected and some of the bare areas seemed to be unrelated to the current positions of the mooring chains, the operational aspects of mooring maintenance and replacement (either using the current type of moorings or AMS) should also be considered in any future plans, as these may have at least as much as impact as the type of mooring used.

Photo 1. Scilly seagrass beds. Photograph taken by Matt Slater of Cornwall Wildlife Trust.

Photo 2. Seagrass reflections. Photograph taken by Matt Slater of Cornwall Wildlife Trust.

2. Introduction

Seagrass bed habitats are identified as a Habitat of Principle Importance (HPI) under the Natural Environment and Rural Communities (NERC) Act 2006 in England and Wales, and are a Priority Marine Feature (PMF) under the Marine (Scotland) Act 2010. They are also listed as a threatened habitat by the Convention for the Protection of the Marine Environment in the North-East Atlantic (OSPAR). Seagrass beds are provided with further protection as the majority of seagrass beds in the U.K. are also designated features of Special Areas of Conservation (SAC) or other Marine Protected Areas (MPA) such as Marine Conservation Zones (MCZ).

2.1 Importance of seagrass

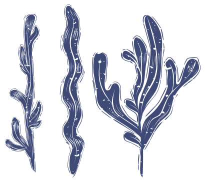
Seagrass meadows are also known to provide a number of key ecological services [1]. These include:

- sediment stabilization
- provision of natural coastal defences in extreme weather [2]
- carbon sequestration [3]
- acting as fish nurseries (which can be very important in areas such as the Mediterranean that have large areas of seagrass beds [4])
- enhancing biodiversity [5].

Two species of seagrass are found within the United Kingdom. These are: Zostera Noltii which is inter-tidal and Zostera Marina which is primarily sub-tidal but also found on the low inter-tidal and in areas of the inter-tidal that do not drain completely.

The importance of seagrass

Habitat for threatened species:

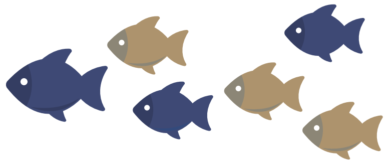


2.5
ACRES OF SEAGRASS MEADOWS

CAN SUPPORT OVER

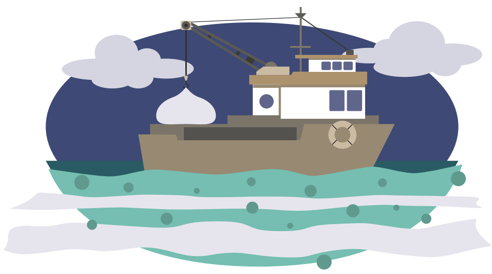
100 million
INVERTEBRATES

AND



80,000
FISH

Commercial fish nurseries:

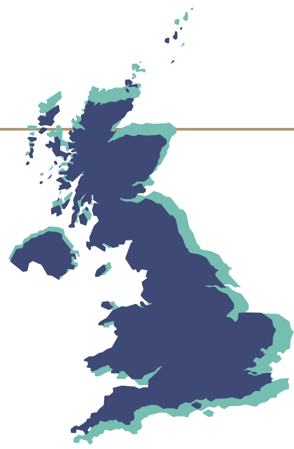


SEAGRASS BEDS SUPPLY

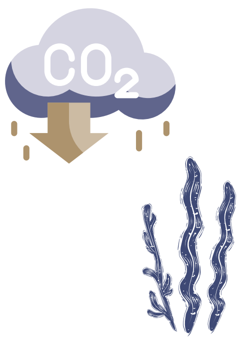
50% OF THE FISHING GROUNDS FOR THE WORLD'S FISHERIES

Coastal defences:

ONE OF THE **most effective** NATURAL DEFENCE SYSTEMS ALONG THE UK COASTLINE



Carbon sequestering:



CARBON IS ABSORBED AND STORED

35 TIMES MORE EFFICIENTLY BY SEAGRASSES THAN BY RAINFORESTS

2.2 Threats to seagrass

There are a number of potential threats to seagrass beds within the U. K. These include:

- Disease: The world's largest and fastest losses of Zostera marina occurred in the 1930's where seagrass beds on both sides of the Atlantic were devastated. This was attributed to seagrass wasting disease, caused by the net-slime mould Labyrinthula zosterae [6].

- Natural cycles: The extent of seagrass beds may change as a result of natural factors such as severe storms and freshwater pulses. Warm sea temperatures coupled with low level of sunlight may also cause significant stress and die back of seagrass [7].

- Physical disturbance: For example, by anchoring, from mooring buoys [8], dredging, the use of mobile bottom fishing gear, and coastal developments that have the potential for changing the hydrological regime.

- Invasive Non-Native Species (INNS): It is thought that some INNS (such as Sargassum muticum and Crassostrea gigas) may outcompete the seagrass [9].

- Increased turbidity: This could be caused by extended dredging contracts, increased freshwater flow and climate change and can cause a reduction in photosynthesis [10].

- Nutrient enrichment: At low levels this may increase production in Zostera, although high nitrate concentrations have been implicated in the decline of mature Z. marina. Phytoplankton blooms, resulting from nutrient enrichment, have been shown to reduce biomass and depth penetration of eelgrass. Eutrophication can also result in a shift to phytoplankton epiphyte or macroalgal dominance [11].

- Marine pollution: Seagrass is known to accumulate contaminants such as tributyl tin and other metals and organic pollutants [12]. Several heavy metals and organic substances have been shown to reduce nitrogen fixation which may affect the viability of the plant, particularly in nutrient poor conditions [7].

Of these potential threats, damage to seagrass beds via anchoring and the scours created by mooring chains are sometimes stated as the greatest [13], although other studies and reviews suggest that it is increased nutrient input that poses the greatest threat [14, 15,].

In the case of moorings, for a net loss to result from an existing bed, new moorings or frequent movement of the moorings would be required. However, the existing moorings likely result in a lower prevalence of seagrass within a particular bed than could otherwise be achieved, either without them being present, or than if an Advanced Mooring System (AMS) that does not result in mooring scars was used.

2.3 Tevi Seagrass Regrowth Challenge Network

The aim of this Tevi Challenge Network is to support the regrowth of seagrass meadows by contributing to the knowledge needed to inform whether mooring providers should transition to advanced mooring systems in the replacement of conventional moorings that scour the seabed with solutions that minimise the mooring's environmental impact, while still delivering essential mooring performance in terms of vessel security and movement.

Most of the seagrass beds within England lie within protected areas and are a feature of these. For this reason, the condition of these beds is regularly assessed by Natural England and the Environment Agency. However, the seagrass bed at Polruan Pool does not lie within any of these areas and consequently this seagrass bed has been poorly studied. Anecdotal evidence suggests that at least part of the current seagrass bed was formed by the dredging of an area of the inter-tidal at Polruan Pool just after the second world war to form an area for boat moorings. This provided suitable conditions for Zostera marina which has become firmly established in this area in the intervening years.

Beds of Zostera marina were identified as being present in the fine sand at Polruan Pool in 1996. This was confirmed in 2002 and estimated to cover 6,800 m2 [16]. The extent of the seagrass bed was mapped in 2013 by Cornwall Wildlife Trust/Falmouth Marine School [17] by extrapolating the data from a relatively few number of transects made by an R.O.V. A much more comprehensive assessment of the extent and density of the seagrass bed was carried out by the Environment Agency in 2019 [18] using Drop Down Video (DDV) where the extent of the seagrass bed was estimated to be at least 2.92 hectares which is over 4 times as large as that estimated in 2002.

To provide the data required by Tevi and give an accurate assessment of the seagrass beds, Ecospan Environmental Ltd were commissioned to undertake a Phase 1 and Phase 2 survey of the seagrass beds in 2020.

2.4. Aims

The aim of the survey at Polruan Pool was to assess the following attributes:

- Extent
- Density (% cover)
- Mean density (shoots per metre squared and/or % cover)
- Maximum leaf length
- Epiphyte coverage of the seagrass leaves
- Presence of wasting disease Labyrinthula sp
- Percentage cover of macroalgae
- Impact of existing moorings on the seagrass
- Presence of INNS and Species of Conservation Importance (SOCI)

Photo 3. Stalked jellyfish. Photograph taken by Fiona Crouch, Natural England.

3. Methods

The extent and density of the seagrass bed were assessed during the Phase 1 drop down/towed video (DDV) which was undertaken on 4th August 2020 whilst all other attributes were measured during the Phase 2 diving survey which was undertaken on 4th-5th September 2020. All surveys were undertaken from Ecospan's MCA cat 3 coded catamaran Coastal Surveyor.

3.1 Drop-down video survey (phase 1)

All available data on historical seagrass extent from previous studies, local knowledge and aerial photography was collated prior to this survey to ensure that all potential areas of seagrass beds were included within the survey area. The survey technique followed that previously employed by Ecospan for surveys of seagrass beds within both the Plymouth and Estuaries SAC [19] and the Falmouth and Helford SAC for Natural England [20]. This provided high definition and greater confidence in both the overall cover of the seagrass bed and spatial differences in its density which are considered essential metrics for a small bed such as the one at Polruan Pool.

3.1.1 Method

The survey area delineating the expected maximum extent of the seagrass beds was divided into 20m transect lines with target stations at 20 m intervals along these lines (Fig.1).

For more information on the method used to complete the DDV survey see the original report from Ecospan here https://tevi.co.uk/challenge-networks.

Fig. 1. Chart of Polruan Pool showing the target positions for the DDV survey.

3.2 Diving survey (phase 2)

3.2.1 Transects

Three 50 m transects were laid within the seagrass bed. The positions were selected on the basis of the results of the Phase 1 DDV survey and in order to give good spatial coverage over the bed. The exact start and end points of each transect were recorded using the vessel's survey quality dGPS which provides sub-metre accuracy.

These positions are given in Table A2 of the Appendix in the full Ecospan report. The transects can therefore be re-laid in exactly the same place in subsequent years and be re-surveyed to enable any changes to be determined if required.

The method used was loosely consistent with the Manual for Scientific Monitoring of Seagrass Habitat [23] and those suggested by the EU project on Monitoring and Managing of European Seagrasses [24]. Each transect was 50 metres long and the percentage cover assessed at 2m intervals using a 0.25 m2 (50 cm by 50 cm) quadrat (Fig. 2).

The following information was recorded from each quadrat:

- Seagrass % cover
- The number of shoots present
- Macroalgae % cover
- Occurrence of INNS and SOCI
- Depth (subsequently converted relative to Chart Datum (CD)
- Evidence of anthropogenic impact, anchor scars, litter etc.

A digital photograph of each quadrat was also taken using a Sea and Sea 2G camera, wide angle lens and a strobe.

Following the methods used by Natural England, all the Zostera shoots in a quarter of the quadrat (0.0625 m2) were collected and placed in labelled bags. Seagrass shoots were cut 2.5 cm above the seabed to ensure that the shoot could regrow before being placed in pre-labelled sample bags. The collected shoots were then analysed on shore where the following data was recorded:

- Maximum length of leaves on each shoot
- Presumed infection in individual leaves by Labyrinthula zosterae
- Cover of individual leaves by epiphytes

Fig. 2. Photograph of the quadrat in use at Polruan Pool.

3.2.2 Impact of existing moorings on the seagrass

The density of moorings is extremely high in this area (with one mooring every 10 metres or so) which substantially complicates any assessment. Typically, an assessment of shoot density and % cover would be made at 2m intervals along transects at 90° from each other (i.e. forming a cross shape with the mooring in the centre). However, since the density of moorings in Polruan is so high, care had to be taken to ensure sufficient distance between the mooring buoy being studied and surrounding ones.

Three moorings were chosen that were sufficiently distant from their neighbours to minimise any interference from these nearby moorings. In practice very few buoys met this criterion that were also within the seagrass bed. However, three moorings that were geographically spaced over the area and were as close as possible to 20 m away from neighbouring buoys were selected. The co-ordinates of these buoys are shown in Table A2 of the Appendix within the full Ecospan report. On each mooring six quadrats were assessed every 2 metres from 0 to 10 m along each of four transects running north, south, east and west from each mooring (giving 24 quadrats in total and 4 replicates at each distance for each mooring).

The data recorded was the same as for the quadrats on the transects.

For more information on the diving method used see the original Ecospan report here https://tevi.co.uk/challenge-networks..

4. Results

4.1 Extent and distribution of seagrass

The first two aims of this assessment (to monitor the extent and distribution and to monitor the distribution, presence and spatial distribution of biological communities) were determined using the DDV data.

A grid (using the Kriging method) was made of the % cover of seagrass at each station using the contouring and 3D surface mapping software SURFER 10. A boundary file was then created and used to create a contour map of the seagrass cover. This contour map has been super-imposed over the chart for the survey area and is shown in Fig. 3.a. The numbers above each of the station positions are the % cover recorded at that station.

It can be seen from this figure that the seagrass bed covers a much larger area than previously thought and is patchy with areas of very high density being very close to areas of low density. This is probably predominantly due to the large number of moorings and the scouring that takes place at the base of some of these. However, sparse and bare areas were also observed during the diving surveys that did not appear to be due to moorings.

Historically, the E.A. and Natural England have separated the seagrass cover into 4 categories ranging from very sparse (5 - 25%) to dense (>76 - 100%). To facilitate a comparison with other areas, this has been done for this data set. The areas within each of the categories is shown in Table 1.

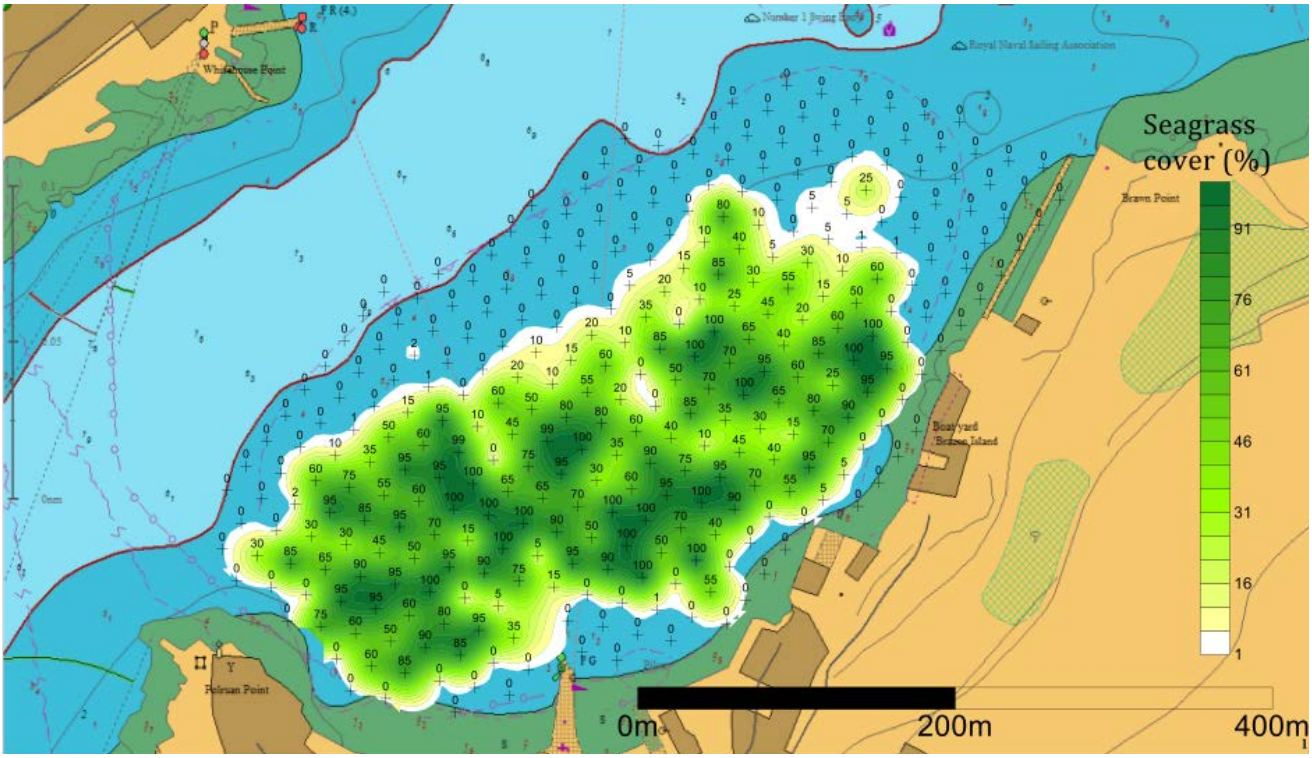


Fig. 3.a. Contour map of seagrass density in Polruan Pool.

Category	Area (m^2)	Area (hectares)	% of total (>5%) area
5-25%	16859	1.69	23.0
>25% - 50%	18116	1.81	24.7
>50% - 75%	20777	2.08	28.4
>75% - 100%	17521	1.75	23.9
Total	**73274**	**7.33**	

Table 1. Area of seagrass bed covered by each density category.

Table 1 shows that of the 7.33 ha total area of seagrass, the distribution across the density categories was remarkably even.

The total area observed in 2019 was over 2.5 times that estimated by the E.A. in 2020 which is probably a reflection of the greater resolution and much greater coverage of the target DDV stations achieved in 2020. Although great caution should be taken when comparing the results of this survey with previous surveys due to significantly different methodologies and survey effort, the area of seagrass present at Polruan Pool appears to have consistently increased in surveys from 1996 onwards. The confidence in this conclusion is low for the reasons given.

4.2 Phase 2 diving survey of the seagrass beds

Fig. 3.b (below) shows the positions of the diving transects, the moorings chosen for the impact assessment and the moorings closest to these survey sites.

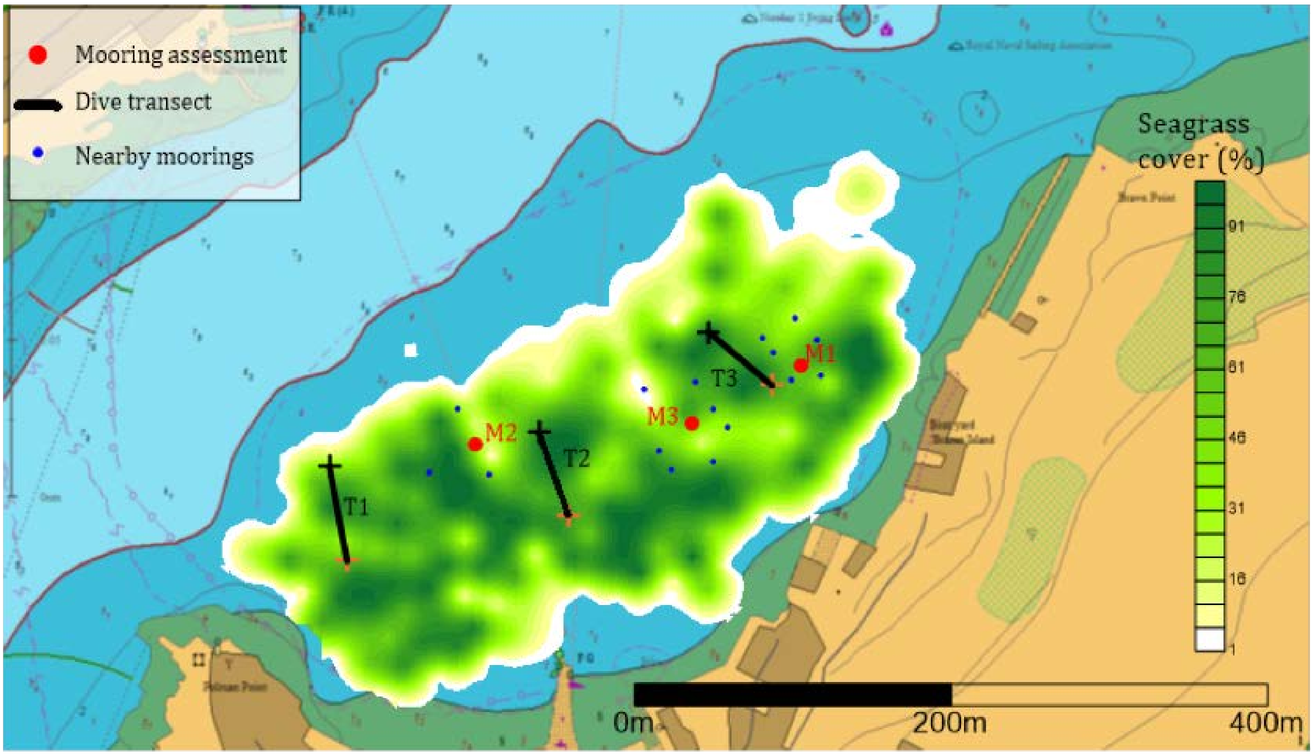


Fig. 3.b. Contour plot of seagrass densities with the diving positions superimposed.

4.2.1 Seagrass bed structure (diving transects)

The mean summary seagrass data for the % cover, density (No. shoots per quadrat) and % cover of macroalgae. is shown for each of the three transects in Fig. 4 with the raw data including tidally adjusted depths for each quadrat shown in Table A3 of the Appendix.

It can be seen from this that the seagrass and macroalgal cover and the mean number of shoots per quadrat is similar for all three transects in the bed. However, the mean % cover and mean number of shoots per quadrat is slightly higher in transect T2. Using a two tailed t-test, the difference is just significant for the % cover between transects 1 and 2 ($p=0.042$) and for the number of shoots between T2 and T3 ($p=0.048$). There are no other significant differences in either the seagrass or macroalgae data.

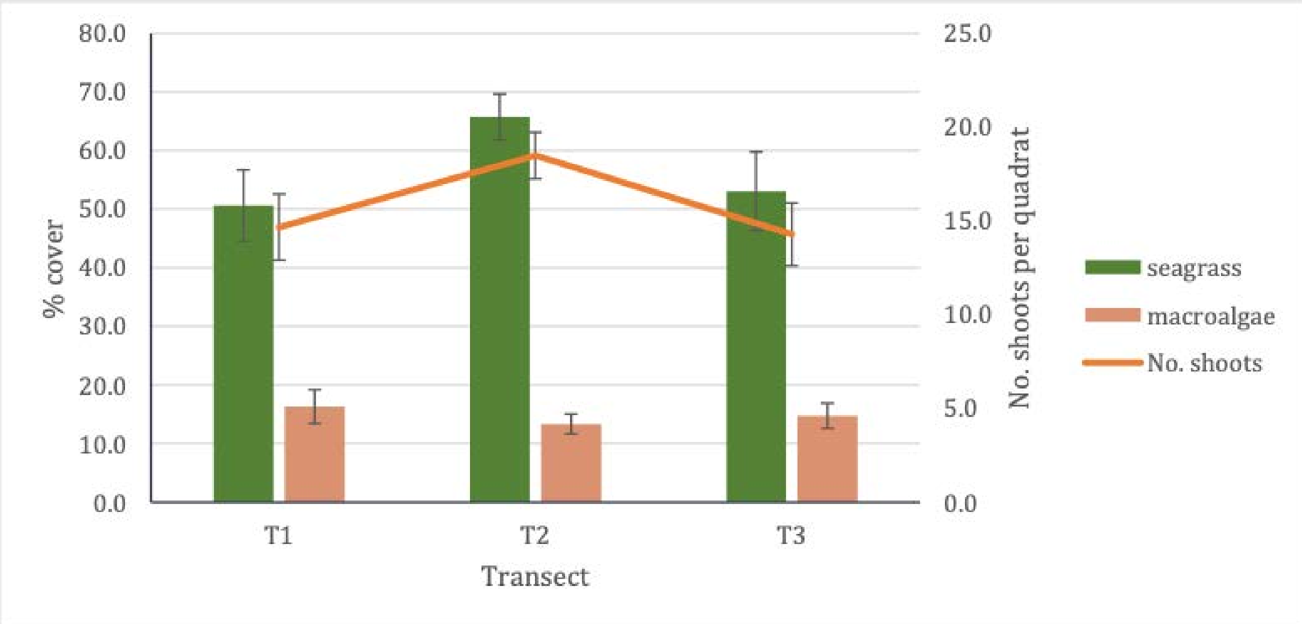


Fig. 4. Summary data for the seagrass present in quadrats at transects T1 to T3. Error bars are Standard Error of the mean (S.E.).

Unsurprisingly, a moderately high correlation was found between the number of shoots per quadrat and the % cover of seagrass (R2 of 0.73) using data from all quadrats (including those from the mooring impact assessments). This is shown in Fig. 5.

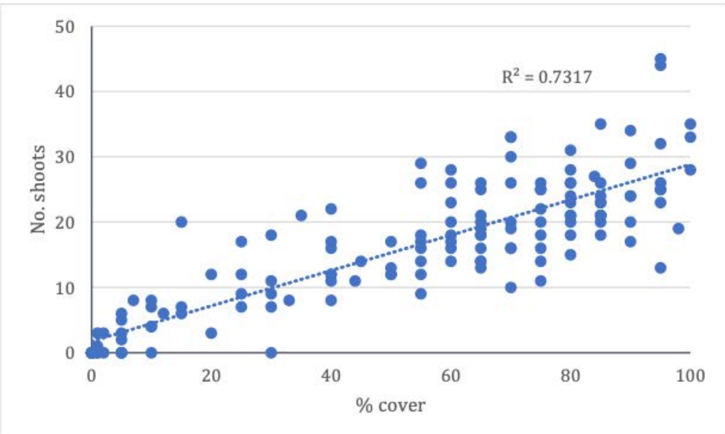


Fig. 5. % cover against the number of shoots per quadrat for all quadrats.

It can also be seen from figure 5 that for a given number of shoots, the % cover recorded had a relatively large range. It is thought that one of the principal reasons for this is the relatively small size of the quadrat compared to the size of the Zostera plants.

It is feasible to get a relatively high % cover with very few plants as the stems might lie just outside the quadrat and equally if the majority of the plant cover lies outside the quadrat it is possible to get a low cover with a relatively high number of shoots.

All three quadrats were set running more or less offshore from the starting position. It can be seen from Fig. 6 that Transect T1 was the deepest (mean depth below chart datum of 2.2m with transect T3 being the shallowest (mean depth 1.0m) and that the depth gradually increased along the transects with distance offshore.

Given the close similarity in depths between quadrats and the patchiness of the seagrass bed, it is not surprising that there was no correlation between either the % cover or number of shoots with depth below C.D. (R2 =0.0042 and R2 = 8 X 10-5 respectively). This data is illustrated in Figs A1 and A2 in the Appendix.

As well as showing the patchiness in seagrass along the transects, figure 6 also shows that transect T2 was much less patchy. It is thought that the primary reason for this is that there were much fewer moorings on/close to this mooring as the transect was laid to the eastern side of the channel used by the Polruan Ferry.

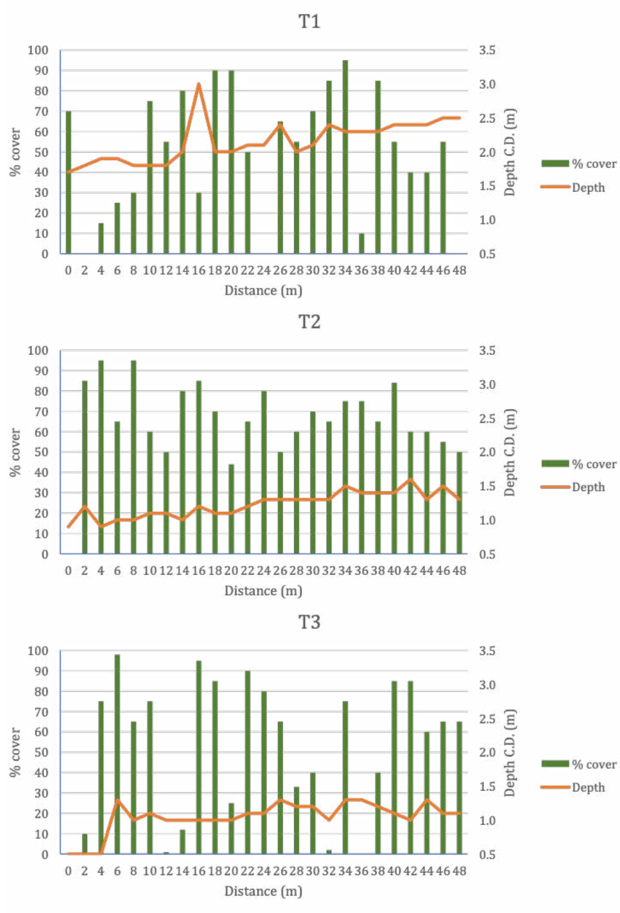


Fig. 6. Variation in the % cover and depth below C.D. within each transect.

4.2.1.1 Leaf data

The summary leaf data (mean maximum length per shoot, mean coverage by epiphytes and mean infection per leaf (% cover)) for all three transects is shown in Fig. 7.

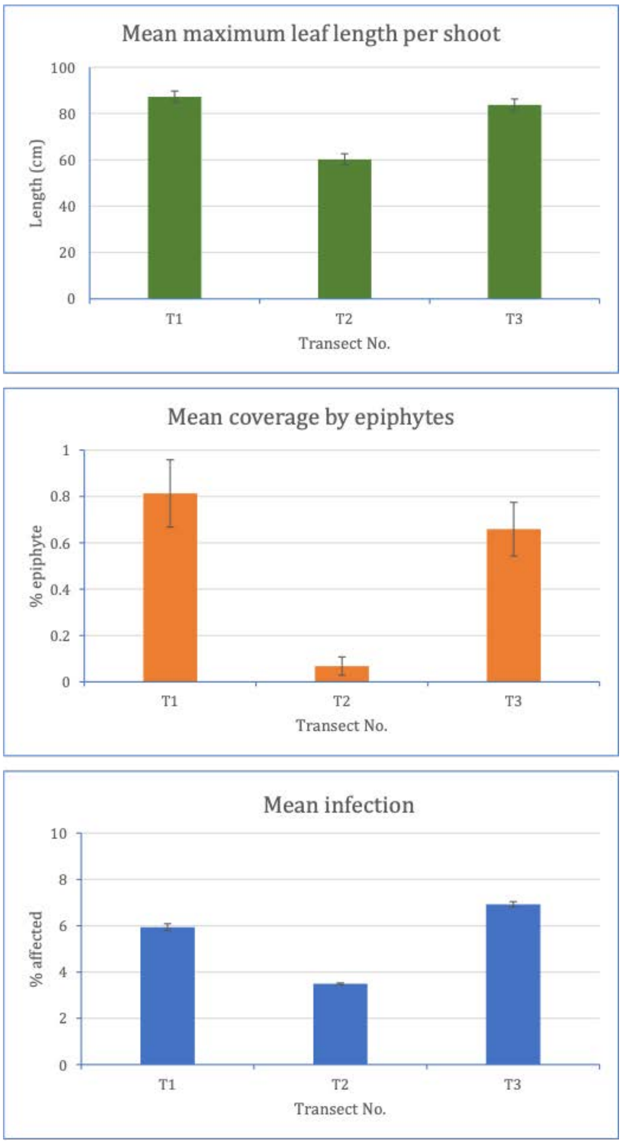


Fig. 7. Summary leaf statistics for each transect.

It can be seen from figure 7 that the mean maximum leaf length per shoot, mean % cover by epiphytes and the mean % cover by infection are all significantly (p<0.001 for all except for the % infection between T1 and T2 which is only just significant p=0.042) lower at transect T2 than on the other transects. There are no significant differences in the leaf data between transects T1 and T3. It can be seen with reference to the scoring criteria for epiphytes and putative Labyrnthula infection that is usually employed by Natural England (Table 2) that the epiphyte score was on average very low with minimal cover apparent. The score for a Labyrinthula infection was also generally low with peak mean infection per shoot being below 15% on all transects. It should be noted that it is not possible to reliably identify infection by Labyrinthula zosterae in the field as the symptoms of infection are similar to other factors such as the natural die back of leaves in the autumn.

Score	Description	% of leaf affected
0	Unaffected	0
1	Minimal cover/infection apparent	0-2
2	Up to a quarter of the leaf affected	3-25
3	Up to half of the leaf affected	26-20
4	Over half of the leaf affected	51-75
5	Almost all the leaf affected	76-100

Table 2. Epiphyte and infection score index.

A possible explanation for the differences between transect T2 and the other transects is that this transect lies to one side of the channel leading from the Polruan ferry. It is possible that this may affect the leaf length due to the boat activity (e.g. prop wash). Since the leaves tend to die back from the tip and epiphytes were also more common at the end of the leaves, this might also explain the reduction in these two parameters.

4.2.2 Mooring impact assessment

4.2.2.1 Percent cover and No. of shoots

The mean % cover at each distance from each of the moorings studied is shown in Fig. 8. The raw data is provided in Table A4 of the Appendix of the full Ecospan report. It can be seen from Fig. 8 that there is considerable variation between the data from the moorings studied. Due to the fact that there are only four data points per mooring and the patchy nature of the seagrass bed, the trends are probably more relevant than whether the distances observed are statistically significant. However, on mooring M1, the cover of seagrass directly below the mooring was significantly different from that at 2, 4, and 6 m. Due to low cover at 8 and 10 m to the south of the mooring, the difference was not significant at these distances. Nevertheless, it is probably reasonable to conclude that the mooring has a localised (up to 2m) effect on the seagrass. The data for each transect for this mooring (Fig. 9) suggests that there may be that a lesser effect that extends as far as 4m from the mooring, but greater sample numbers would be required to determine this.

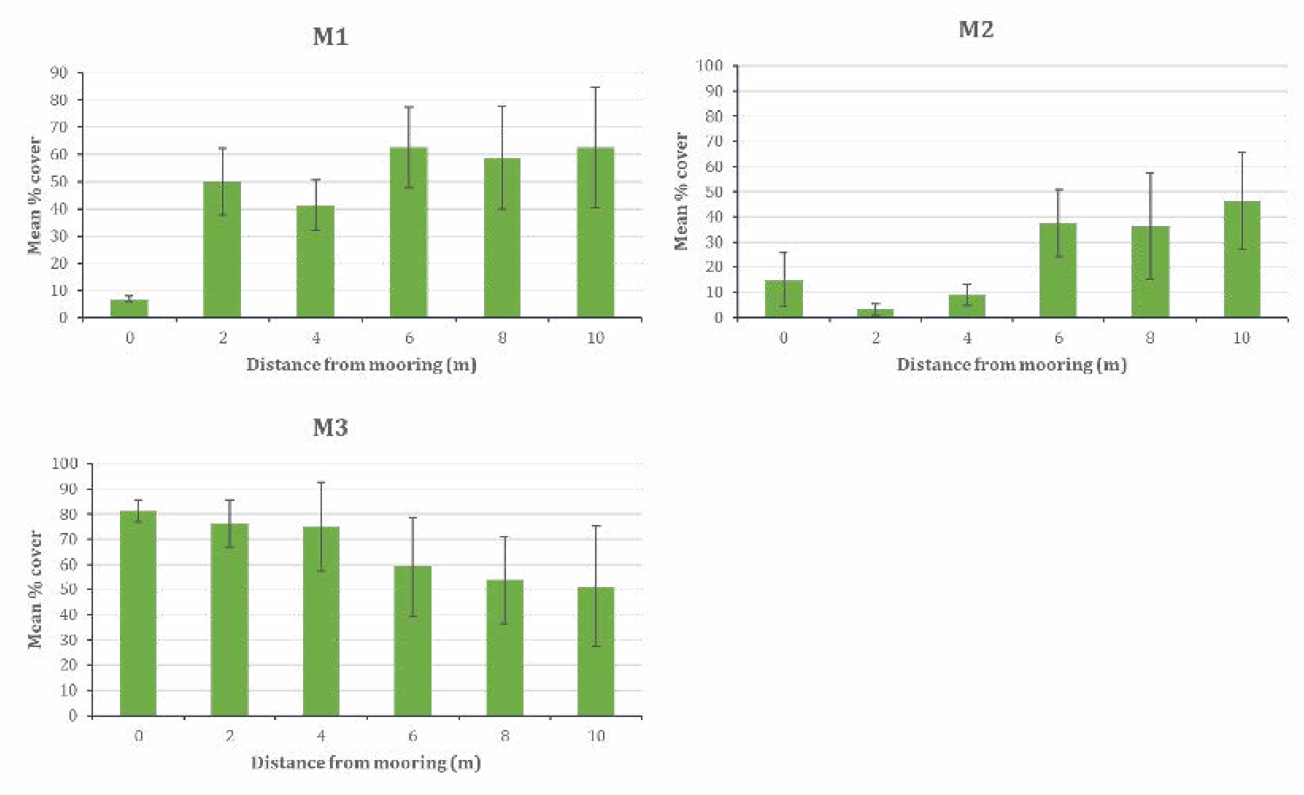


Fig. 8. Effect of the distance from a mooring on the % cover at each station (+/- S.E.).

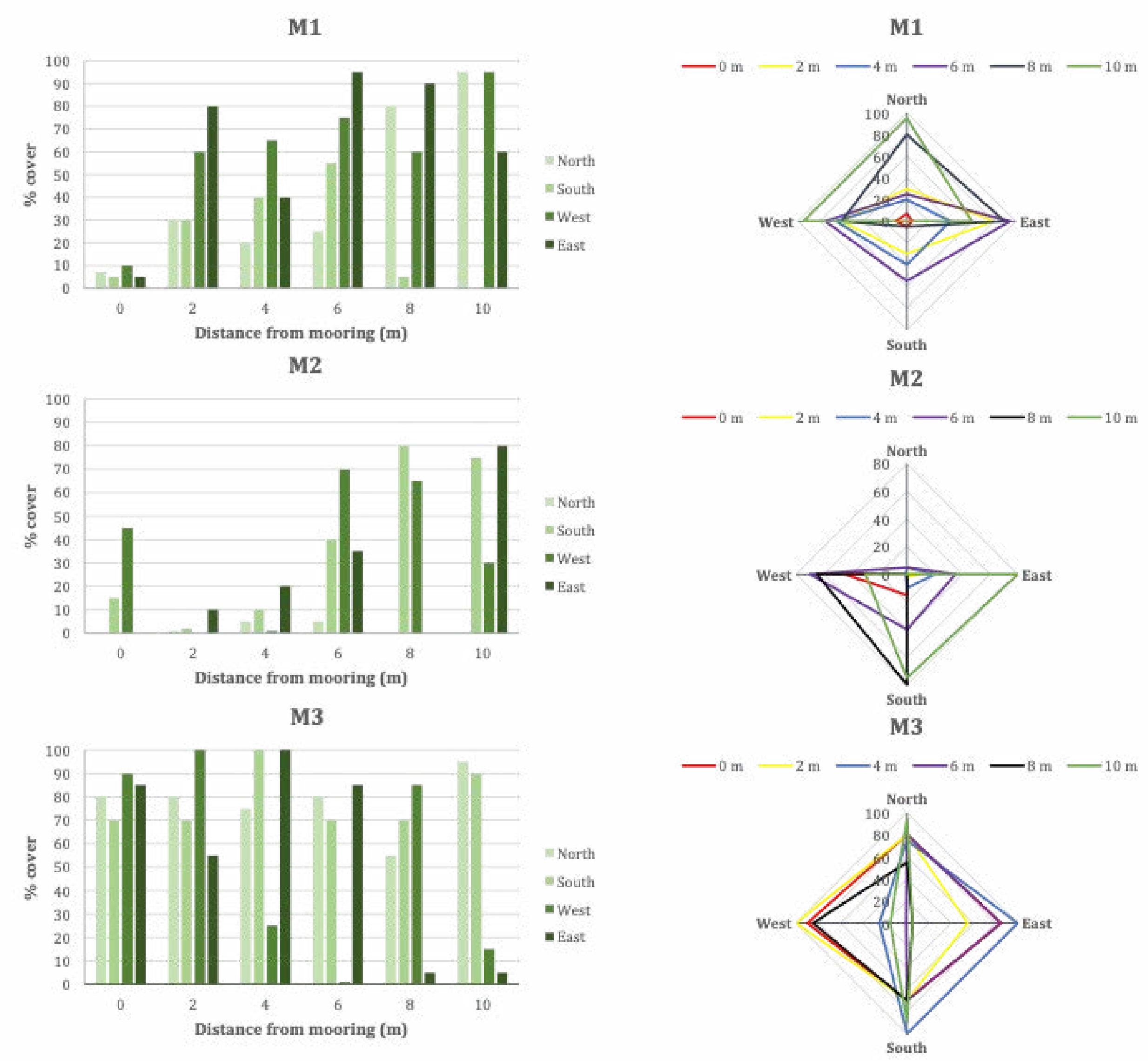


Fig. 9. Effect of the distance from a mooring on the % cover on each of the transects on each mooring.

There are no significant differences in the % cover at any of the other moorings studied, but it is probable that a limited effect may be present up to 4 m from mooring M2 which is the deepest of the moorings. No impact at all was observable at mooring M3, where the percentage cover of seagrass was high directly under the mooring (seagrass was observed to be growing through the chain) (Fig. 10).

The shoot data shows an extremely similar pattern to the % cover data with the same differences being significant at M1 and no other significant differences. The mean % cover with distance from each of the buoys is shown in Fig. 11, with the individual data being shown in Fig. A4 of the Appendix in the full Ecospan report.

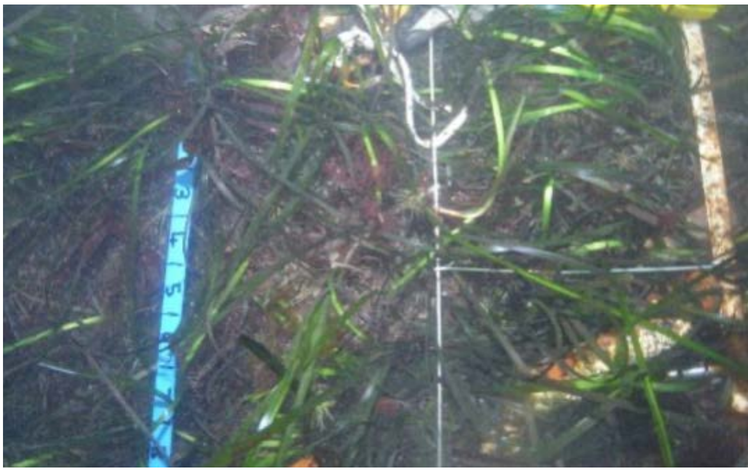


Fig. 10. Photograph of a quadrat under the mooring at M3 showing dense seagrass growing through the chain.

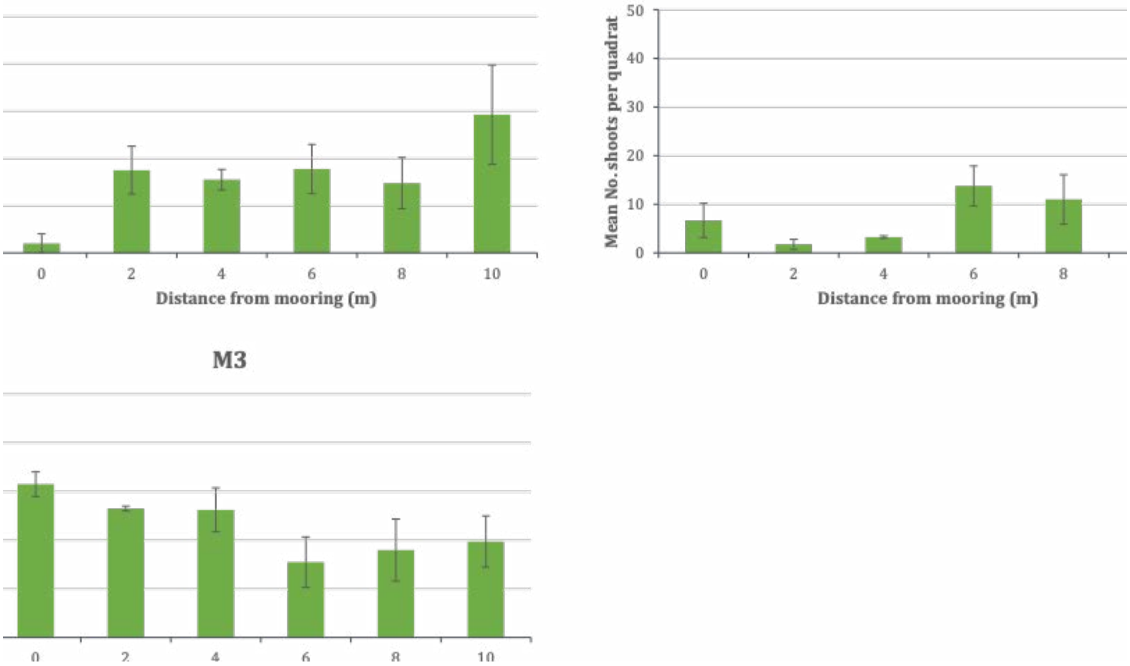


Fig. 11. Photograph of a quadrat under the mooring at M3 showing dense seagrass growing through the chain.

4.2.2.2 Leaf data

The mean maximum leaf length per shoot at each distance is shown in Fig. 12 together with the % cover by epiphytes and the mean % of putative infection by Labyrinthula zosterae. Overall, the data suggest that there is no impact on any of these parameters where the plants are present.

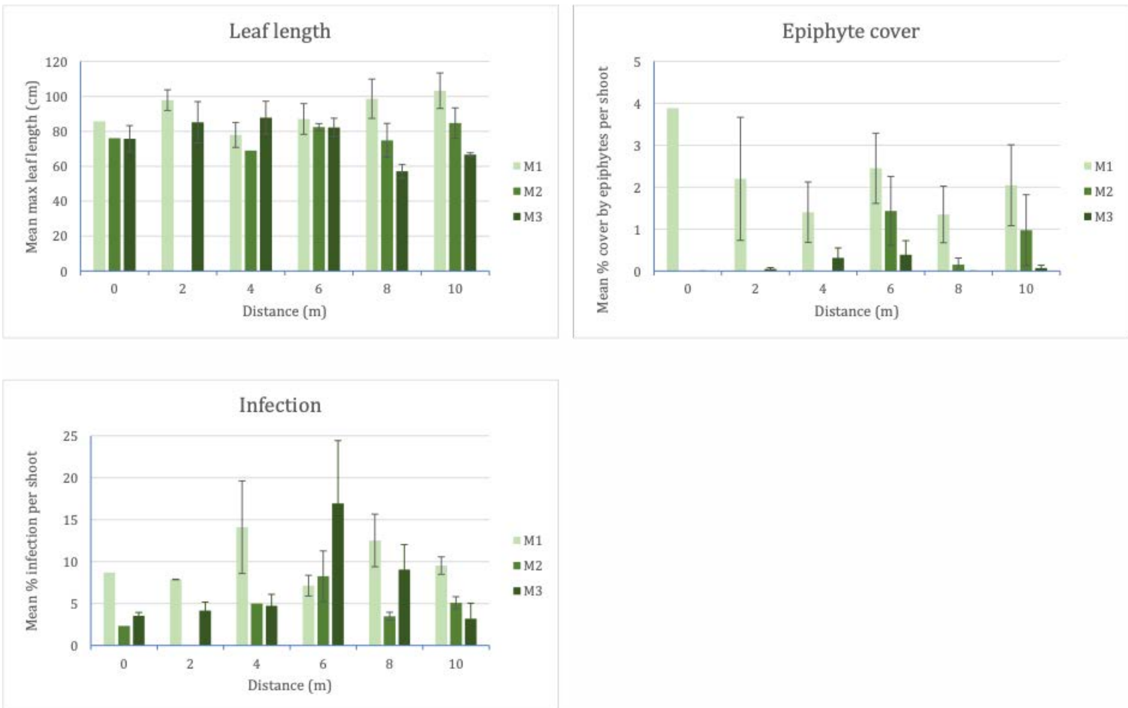


Fig. 12. Mean maximum length per shoot at each distance from each mooring.

4.2.2.3 Macroalgae

The mean coverage per quadrat of macroalgae at each of the moorings assessed is shown in Fig. 13. The data for each of the directional transects are shown in Fig. A4 of the Appendix of the full Ecospan report. It can be seen from these figures that there are no consistent trends between the moorings with mooring M1 having a greater coverage of macroalgae up to 2m away, M2 having less macroalgae up to 4 m away and M3 showing no differences. Not withstanding the low statistical power, the only statistical differences were the decrease in macroalgal cover observed at M1 at 6 and 10 m from the mooring.

As with the seagrass cover, further work with greater numbers of observations would be required to determine whether macroalgae cover is positively affected by the moorings (e.g. if it colonises areas that have become devoid of seagrass) or not. This study does not provide strong evidence for either a positive or negative impact on macroalgal cover.

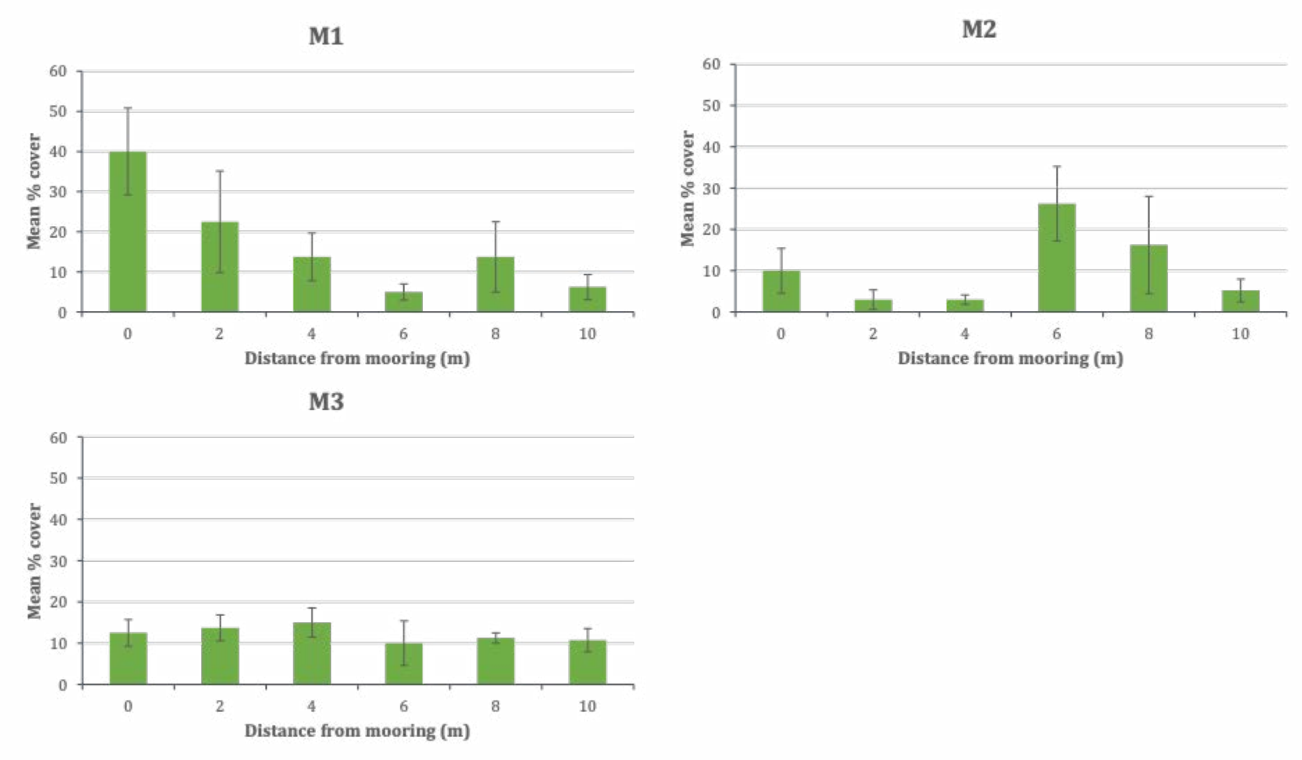


Fig. 13. Variation in the mean % cover of macroalgae with distance from each mooring (+/- S.E.).

4.3 Flowering plants

Although it is known that Zostera marina flowers and produces seeds from the early summer until autumn [26, 27], no flowering plants were observed over the course of this survey. One plant was found to have seeds (Fig. 14).

This compares to the results from other studies in the region (e.g. the seagrass monitoring within Plymouth Sound and Estuaries [28] where the incidence of flowering was approximately 5%). However, the current study was undertaken in September which is the end of the season and is consistent with the low numbers observed in a study in Torbay at the end of September [21]. It is therefore likely that this is a function of the time of year in which the surveys are undertaken.

Fig. 14. Photograph of a Zostera marina leaf with seeds.

4.4 Non-Native Species/Species of Conservation Importance

It was expected that some of the more common and conspicuous Invasive Non Native Species (INNS) such as Sargassum muticum would be observed. In the event, no INNS were recorded during this survey.

No seahorses were observed at all during the course of these surveys. This does not indicate that seahorses are not present as they can be very difficult to find even in areas known to harbour them. Given the size of the bed and the seagrass density, it is considered possible that seahorses are present within it.

During the DDV survey one stalked jellyfish was observed. It was not possible to identify which species it was. However, during the diving survey, three specimens of Calvadosia campanulata were observed (Fig. 15). The populations of this species of stalked jellyfish are known to fluctuate markedly throughout the year with this species being particularly prevalent in autumn [29, 30]. This species is nationally scarce and is UKBAP Priority Species, species of principal importance for the purpose of conservation of biodiversity under the Natural Environment and Rural Communities Act 2006.

Fig. 15. Photograph of the stalked jellyfish Calvadosia campanulata. Photograph courtesy of David Fenwick www.aphotomarine.com.

4.5 Anthropogenic influences

Other than mooring chains extremely few anthropogenic inputs were observed. These were the occasional piece of litter and one discarded/lost fishing line.

Photo 4. Eelgrass marazion from SUP. Photograph taken by Matt Slater.

5. Discussion and conclusions

5.1 Seagrass extent

This study is the most comprehensive study of the extent of the seagrass bed at Polruan Pool to date. Although the DDV survey was hampered by the density of moorings (particularly on the shallower areas of seagrass) it is considered that the full extent and density of the seagrass within the existing bed has been captured.

The bed (defined as a seagrass cover of 5% or greater) covers an area of 7.33 hectares. This is over 2.5 times that estimated by the E.A. in 2019 (which was of lower resolution and did not cover some of the area that was shown to have seagrass present in this study). Although great caution should be taken when comparing the results of this survey with previous surveys due to significantly different methodologies and survey effort, the area of seagrass present at Polruan Pool appears to have consistently increased in surveys from 1996 with empirical data increasing from 0.68 hectares in 2002 to an order of magnitude larger in 2020. The confidence in this conclusion, for the reasons given, however, is low.

It is well known that the depth of water is often a critical factor in limiting the seaward extent of Zostera marina beds due to the reduction in light with depth [31]. For this seagrass bed, however, although this may be the case for the northern edge of the bed, it does not explain the lack of seagrass on the north eastern edge (Fig. 3). From the DDV survey, those stations surveyed in this area appeared to have suitable sediments. The reason for the lack of seagrass in this area may therefore be some hydrodynamic factor or simply that it is yet to be colonised by seagrass.

5.2 Bed structure

The mean seagrass cover was moderately high for all three transects ranging from just over 50% to 65% and correlated well with the number of shoots per quadrat. However, the density of seagrass beds was patchy over most of the bed, with areas of high seagrass cover being close to areas of no or low seagrass cover. It is postulated that one of the reasons for this is the very high density of moorings that are present over the seagrass. However, during the diving surveys, areas that had low densities and didn't appear to be affected by moorings were observed. This could be related to historical disturbance of the rhizomes when the ground chains and moorings are re-laid (which could lead to bare areas being present in areas that are not currently impacted by the chains if they are not re-located in precisely the same position from year to year).

The transect data showed that there was no correlation in the seagrass density with the depth of the quadrat. This may be due to the fact that the transects were all in a similar depth and did not span the northern edge of the bed where the depth of water may be a critical factor.

5.3 Plant health

The epiphyte cover and mean infection of leaves was low on all transects and mooring dives undertaken. The mean maximum length of the leaves per shoot was also relatively long with mean values ranging from 60 cm on Transect T2 to 87 cm on transect T1 with some leaves exceeding 140 cm in length. It is therefore concluded that the health of the plants is good.

As well as having shorter leaves, plants on transect T2 tended to have lower epiphyte scores and a lower degree of infection. One possible explanation for the differences between this transect and the other transects is that it lies to one side of the channel leading from the Polruan ferry. It is possible that this may affect the leaf length due to the boat activity (e.g. prop wash). Since the leaves tend to die back from the tip and epiphytes were also more common at the end of the leaves, this might also explain the reduction in these two parameters.

Seagrass beds are known to die back to varying degrees over autumn and winter [32] which makes it difficult to distinguish the difference between natural die back and an infection with Labyrinthula zosterae. The data for the proportions of leaves infected in this study (or any other where infection has not subsequently been determined in the laboratory), particularly as it was undertaken in September, are likely to be an overestimate of infection. Since some authors report that current European strains of Labyrinthula zosterae are not virulent [33], this may not be of critical importance.

5.4 Impact of moorings

For two of the three moorings examined, there appeared to be a localised reduction in both the % cover and the number of shoots at stations which might extend up to 4m from each mooring. Due to the low statistical power of the current study (n=4 at each distance) only the reduced seagrass density immediately below the mooring on M1 was statistically significant. The fact that no reduction in seagrass cover or number of shoots was observed at mooring M3 suggests that the type of mooring and other aspects (such as depth of the mooring, degree of shelter, size of the mooring compared to the boat on it etc) may also have a critical effect.

Even though the data suggests that any effect is likely to be extremely localised, given the density of moorings in Polruan Pool (approximately 200 in the seagrass bed), any reduction in this impact is likely to benefit the integrity and resilience of the bed. This would probably also reduce the patchiness of the bed and therefore increase the mean coverage of seagrass over the bed as a whole. However, since one mooring was totally unaffected and some of the bare areas seemed to be unrelated to the current positions of the mooring chains, the operational aspects of mooring maintenance and replacement (either using the current type of moorings or AMS) should also be considered in any future plans, as these may have at least as much of an impact as the type of mooring used.

For recommendations for future diving surveys see original report from Ecospan here https://tevi.co.uk/challenge-networks.

Photo 5. Isles of Scilly seagrass. Photograph taken by Fiona Crouch, Natural England.

5.5 INNS/SOCI

The lack of INNS observed in this study was somewhat surprising given the abundance of species such as Sargassum muticum along our coasts. However, the absence of INNS is important as species such as Sargassum can compete with Zostera marina and cause a reduction in the quality of the bed.

The presence of several stalked jellyfish (Calvadosia campanulata) which is listed as nationally rare, is a UKBAP Priority Species and species of principal importance for the purpose of conservation of biodiversity under the Natural Environment and Rural Communities Act 2006 will need to be considered for any projects undertaken by the Harbour Authority that might affect these populations. However, it should be noted that these species live attached to the blades/ fronds of seagrass and seaweeds which may be subject to autumn/winter die-back and, consequently, their population is known to show marked seasonal variation.

No seahorses were observed during this survey, but as these fish are shy and extremely difficult to spot in dense seagrass, the fact that none were observed does not mean that they are not present within this bed. Given the size of the bed it is thought possible that there is a population here. Both seahorse species found in UK waters (long snouted (Hippocampus guttulatus) and short snouted (Hippocampus hippocampus)) are protected under the Wildlife and Countryside Act 1986 and therefore any activities that might affect them will require a Marine Licence from the MMO.

For references and appendix graphs (including DDV stations and transect positions) see the original report from Ecospan here https://tevi.co.uk/challenge-networks.


Photo 6. Seagrass. Photograph taken by Fiona Crouch, Natural England.

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Contributors:
This report is a summary of Ecospan's (www.ecospan.co.uk) full survey report which can be found on Tevi's website under the Challenge Network tabs (www.tevi.co.uk/challengenetworks)

Designed by Eight Wire
www.eightwire.uk

Communications:

www.tevi.co.uk

@TeviCornwall

info@tevi.co.uk

Tevi

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