Solent & Isle of Wight Intertidal Seagrass Survey 2023

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Citation

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

Solent Maritime was designated a European Marine Site (Special Area of Conservation) in 2005, with ‘Mudflats and Sandflats not covered by seawater at low tide’ as a feature and ‘Intertidal seagrass beds’ as a sub feature. This site was last surveyed in 2019 and required an up-to-date mapping of extent and distribution to inform management and conservation measures. Therefore, Natural England Commissioned this report to inform on the condition of the site.

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Executive summary

Arcadian Ecology & Consulting Ltd were appointed by Connor Reid, Lead Marine Advisor, at Natural England to undertake intertidal seagrass surveys within the Solent and Isle of Wight. Surveys were conducted in known areas where seagrass has been mapped previously, as well as a small number of additional beds that have not been surveyed. Surveys assessed the current extent and condition of all seagrass habitats and communities at the peak of their natural cycle.

The Solent waterbody is composed of a myriad of designated sites, all of which have been designated for a wide range of habitats and species. Several of these sites are host to ecologically significant intertidal seagrass *Zostera* species, either as a designated feature in its own right (Solent Maritime Special Area of Conservation (SAC)) or as supporting habitat for bird species (Chichester and Langstone Harbours Special Protection Area (SPA), Solent and Southampton Water SPA and Portsmouth Harbour SPA).

All intertidal surveys were carried out on foot during spring low tides between August and September 2023. A total of 17 survey areas were identified within the Solent and Isle of Wight, based on a desk study. GPS tracks were recorded around previously mapped seagrass beds using GPS-equipped smartphones with an accuracy of up to 10m. These were recorded as either positive/presence tracks or negative/absence tracks as well as GPS points for areas of interest such as individual patches of seagrass or signs of anthropogenic pressures. Once a seagrass bed was located, the extent was mapped by walking along the outer boundary of the bed. Georeferenced photographs were taken at regular intervals using a tablet/smart phone, with a subset of these including 50 x 50 cm quadrat images for percentage cover estimation.

Seagrass was recorded in all areas surveyed where the beds were accessible. This included a mix of *Z. noltii, Z. marina* and *Z. marina* ecotype. All of the harbour sites (Portsmouth, Langstone and Chichester) comprised a substrate dominated by mud while the other sites were composed of a mix of sand, gravel and cobbles. A total seagrass bed coverage of 251.18ha was recorded across the areas surveyed. Beds consisting of a mix of *Z. noltii* and *Z. marina* ecotype made up approximately 40% of this total area, covering 101.04ha, closely followed by mixed beds of *Z. noltii* and *Z. marina* which covered a total area of 88.05ha (35% of all seagrass beds recorded).

Seagrass was recorded across 18 designated sites within the Solent and Isle of Wight including SSSIs, SPAs, SACS, Ramsars and MCZ. Analysis was undertaken to determine the total hectares of seagrass recorded within each MPA. The majority was found within SSSIs and Ramsar sites with a total of 228.48ha of seagrass in these areas while MCZs had the smallest seagrass beds within the survey area with a total of 23.02ha observed.

Coverage of seagrass across the survey areas was largely similar to previous years survey data, however, there were notable expansions and contractions of beds. In addition, new areas were observed and mapped which had not been included in the

seagrass inventory previously. This included a new seagrass bed at Fareham Lake off the coast of Porchester, and new beds within Mill Rythe and the Kench around Hayling Island.

Density was variable across the survey locations ranging from very dense beds in places to sparse and patchy areas of seagrass. Algae was widespread across the sites and there were multiple signs of anthropogenic pressures in the beds including gauges/dredge marks, pollution and discolouration of mud due to unknown causes. However, no non-native species or pathogens were observed at any of the sites. Comparisons were made with data from previous surveys of these seagrass beds where possible. Initial findings from surveys have found that the extent of seagrass in the Solent has increased at a number of survey locations, despite some small contractions in range at others. Additional seagrass beds were found that had not been surveyed previously.

Statistical analysis showed that the average seagrass bed size significantly increased between 2019 and 2023 ($t=-3.398$, $p<0.05$) from 3.89ha to 5.08ha. This is an increase of 31% within the areas re-surveyed. It should be noted that large areas of “mosaic” beds, comprising many smaller patches, were mapped as single beds with the extent drawn around the entire group of patches. Therefore, some areas included within the calculations would include sediment patches rather than a complete seagrass bed and consequently produce a slight overestimate of seagrass bed size. Caution should be exercised when interpreting the results of this data.

It is recommended that areas which were not accessible in 2023 (i.e. East Gosport, Medina, Needs Ore, Oar Rithe and Yarmouth,) are re-surveyed in the future using an alternative survey method such as surveying by drone, boat, scuba diving and/or waterproof handheld camera to provide an up-to-date assessment of the extent and condition of seagrass at these locations.

A number of other areas were identified during the 2023 surveys where it appeared that seagrass extent had increased beyond the survey areas, but it was not possible to survey their entirety due to time constraints, incoming tides and difficulties with access such as the presence of large impassable channels. Some beds also extend out into the shallow subtidal areas which were outside the scope of these surveys which focussed on intertidal beds. These sites should be surveyed further to determine their full extent of seagrass. In addition, data from drone surveys undertaken by the University of Portsmouth should be obtained and collated with that gathered from these surveys to assess the full extent of seagrass at Farlington.

Chichester Harbour Conservancy will also be conducting seagrass surveys in the harbour in 2024. This will extend these surveys carried out within Chichester Harbour in 2023 and include the mapping of additional areas that surveyors were unable to reach due to time, tide and access constraints.

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Introduction

Background

Arcadian Ecology & Consulting Ltd were appointed by Connor Reid, Lead Marine Advisor, at Natural England to undertake intertidal seagrass surveys within the Solent and Isle of Wight. Surveys were conducted in known areas where seagrass has been mapped previously, as well as some additional beds that have not been surveyed before. Surveys assessed the current extent and condition of all seagrass habitats and communities at the peak of their natural cycle.

Natural England is the government's advisor on the natural environment. They provide practical advice, grounded in science, on how best to safeguard England's natural wealth for the benefit of everyone. Their remit is to ensure sustainable stewardship of the land and sea so that people and nature can thrive. It is Natural England's responsibility to see that England's rich natural environment can adapt and survive intact for future generations to enjoy.

Seagrass beds within the Solent and Isle of Wight have been surveyed by Hampshire & Isle of Wight Wildlife Trust (HIWWT) and others on a near annual occurrence. There are over 200 hectares of intertidal seagrass beds in the Solent Maritime Special Area of Conservation (SAC), with the largest beds being found in Langstone and Chichester Harbours, and along the north coast of the Isle of Wight (Marsden and Chesworth, 2014 and 2015; Isle of Wight County Council, 2004).

Surveys have recorded three species of seagrass in intertidal areas of Solent Maritime SAC: dwarf eelgrass *Zostera noltii*, common eelgrass *Zostera marina* and narrow-leaved eelgrass *Zostera angustifolia,* as well as two species of tasselweed *Ruppia* spp. (Marsden and Chesworth, 2015). The taxonomic status of *Zostera angustifolia* is currently under consideration and genetics now consider it to be an ecotype of *Zostera marina* (JNCC, 2024). Therefore, this report will refer to the *Zostera marina* ecotype instead of *Zostera angustifolia*.

Site Description

The Solent waterbody is composed of a myriad of designated sites, all of which have been designated for a wide range of habitats and species. Several of these sites are host to ecologically significant intertidal seagrass *Zostera* species, either as a designated feature in its own right or as supporting habitat for bird species. These sites are:

Designated feature:

- Solent Maritime SAC

Supporting habitat:

- Chichester and Langstone Harbours Special Protection Area (SPA)
- Solent and Southampton Water SPA
- Portsmouth Harbour SPA

Remit and Scope of the Report

This report details the findings of the intertidal seagrass surveys within the Solent and Isle of Wight in August and September 2023. It provides characterisation of intertidal seagrass extent, distribution, and density across all sites, and also provides comparisons to previous data gathered, where available.

Methodology

Pre-survey Deskwork

A review of all known survey data post publication of the 2006-2018 Seagrass Inventory was collated and incorporated into an up to date GIS layer. This was referenced with the Magic Map National Seagrass Layer to understand the chronology and extent of survey coverage to date. The current inventory GIS layers detail surveys by year as well as seagrass locality, polygon extents, and positive and negative record data points.

GIS data of areas surveyed since 2018 as part of HIWWT's ongoing restoration projects, and not currently included in the national layer, were added. These GIS layers were then used to assess all intertidal and subtidal areas against Ordnance Survey base mapping, satellite imagery, coastal habitat data, site specific data and local knowledge. It was then possible to identify gaps with potential for seagrass (with no survey data). This information informed sampling design and effort required to update the project-wide area within the time period required.

Through HIWWT's work on seagrass restoration projects, areas have been visited and partially surveyed including seagrass sites not currently incorporated on the Magic Map National Seagrass Layer e.g. areas of the Kench and adjacent mudflats in the south-east corner of Langstone Harbour. The survey work conducted for Natural England in 2018, which focused on the Isle of Wight beds within the Solent Maritime SAC, indicated some areas where seagrass beds may be developing, compared with the relatively stable extent of the more established beds surveyed since 2011.

Based on an initial review of the national layer and inventory information, whilst taking into account the short survey window remaining, the survey areas were prioritised to seagrass beds last surveyed over five years ago. These included beds from the eastern harbours, New Forest coast and the Isle of Wight and was therefore considered to be representative of the Solent area.

Field Survey

All intertidal surveys were carried out on foot during spring low tides using Survey123 ArcGIS mapping software. Existing seagrass location maps were loaded onto Survey123 ArcGIS prior to survey and used as a guide for surveyors (and) to ensure areas for resurvey were covered, and to facilitate the search for previously unrecorded beds close to each location.

Survey Area

A total of 17 survey areas were identified within the Solent that had previously recorded seagrass beds. Beds were grouped into locations and included on the ArcGIS maps.

These are listed below and a map indicating the locations and extent of previously mapped seagrass beds is shown in Map 1 with more detailed maps of each survey area shown in Maps 2 to 7.

East Solent (Map 2):

- Needs Ore, Beaulieu
- Calshot

Portsmouth Harbour (Map 3):

- East Gosport (no access in 2023)
- Fareham Lake, Cams Bay

Langstone Harbour (Map 4):

- Farlington (partially surveyed)
- The Kench
- West Hayling

Chichester Harbour (Map 5):

- Crake Rithe
- Horse Pond to East Head
- Mengham Rithe, East Hayling
- Mill Rithe, East Hayling
- Oar Rithe (no access in 2023)
- Yachthaven, East Hayling

Isle of Wight (Maps 6 and 7):

- Gurnard
- Medina (no access in 2023)
- Seagrove to Priory Bay
- Yarmouth

Survey Methodology

The survey method followed the Marine Monitoring Handbook (Davies et al., 2001), in line with previous survey methods used in the 2018 survey and inventory project to ensure consistency, and to enable comparative analysis and incorporation with existing datasets. All necessary landowner permissions were secured prior to survey. All intertidal surveys took place on foot during spring low tides between August and September 2023. For surveys within harbours, mud patterns and mudders were worn to enable surveyors to walk across the mudflats.

During surveys, GPS tracks were recorded around previously mapped seagrass beds using GPS-equipped smartphones with an accuracy of up to 10m. These were recorded as either positive/presence tracks or negative/absence tracks as well as GPS points for areas of interest such as individual patches of seagrass or signs of anthropogenic

pressures. Negative tracks are areas where surveyors have walked but have not found the presence of seagrass.

Once the seagrass bed was located, the extent was mapped by walking along the edge of the bed boundary, using the accepted > 5% shoot density to indicate a continuous bed (Figure 1).

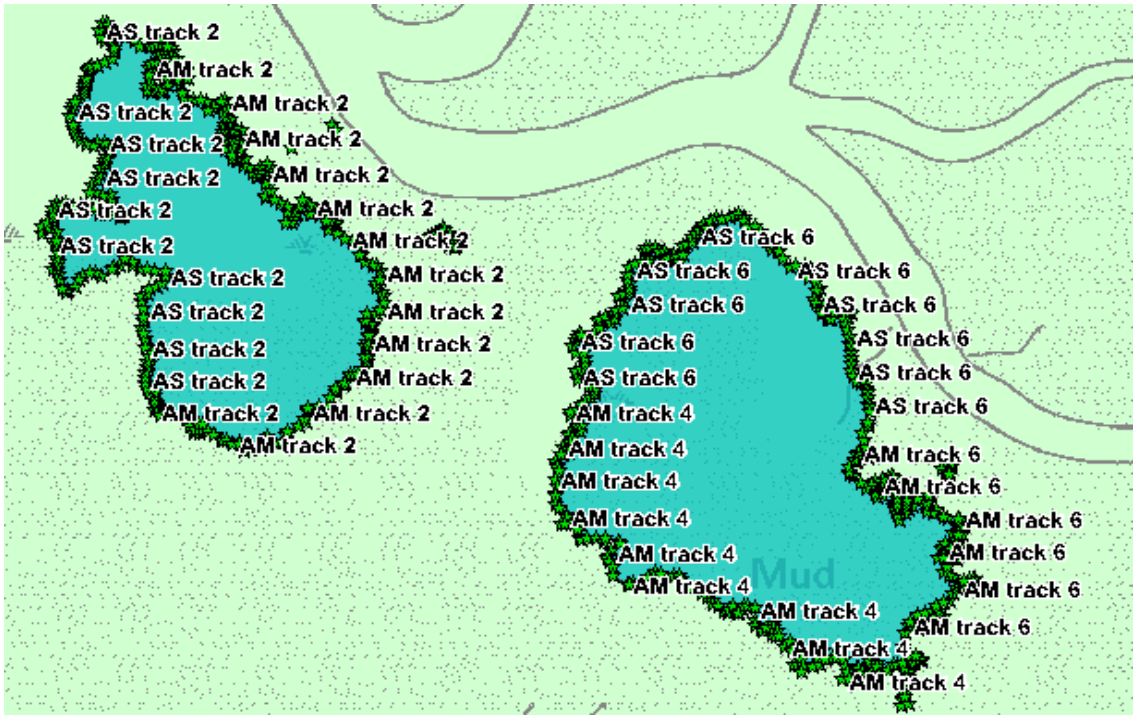

Figure 1. Example of how the outer edge of a seagrass bed was walked and mapped

If a bed edge could not be walked due to water depth or other limits, an appropriate positive track was recorded to link with the bed edge (then points showing the extent were mapped later by joining the dots), as shown in Figure 2. As far as possible, walking into and across the seagrass beds was avoided in order to minimise trampling/damage to the seagrass bed.

Figure 2. Example of how a seagrass bed was mapped when it was not possible to walk along the edge

Georeferenced photographs were taken at regular intervals using a tablet/smart phone, with a subset of these including 50 x 50 cm quadrat images for percentage cover estimation.

The quadrat was placed down regularly but at random intervals around the beds to give a good representation of the variation in seagrass beds. The number of quadrats was scaled appropriately to account for bed size, range of condition, notable changes or bed edge effects. They also included examples of presence of Invasive Non-Native Species (INNS), if present, anthropogenic impacts or the presence of significant marine litter (e.g. fishing gear, water sports equipment, marine plastics, industrial/commercial waste). A minimum of at least three quadrats were taken for each bed with the number of quadrats being proportionate to the size of the bed; i.e. more photographs were taken for larger beds.

Where possible, discrete patches were mapped separately if larger than approximately 3m in diameter (the maximum accuracy of the GPS), or as point data if plants were present as smaller patches or isolated plants. However, these were mostly grouped together into larger beds due to time and tidal constraints. Large areas of “mosaic” beds, comprising many smaller patches, were mapped as single beds with the extent drawn around the entire group of patches.

The following attributes were assessed at the data/quadrat points, in line with the previous inventory format. The main seagrass attributes that were recorded included:

- Distribution: presence and spatial distribution of biological communities: mapping and biotope assignment should be taken to species level (e.g. *Z. noltii*, *Z. marina* or *Z. marina* ecotype);
- Extent;
- Density (% cover of seagrass in sample stations);
- Sediment composition and distribution across the sub feature;
- Anthropogenic pressures;
- Non-native species and pathogens across the sub feature (% cover of any non-natives at walkover sites); and
- Water quality – nutrients: abundance of macroalgal matts across the sub feature (take notes of any highly affected seagrass beds to this pressure in walkovers).

Surveyors and timings

Surveys were conducted between 9th August and 29th September 2023. The survey team comprised staff from Arcadian Ecology & Consulting Ltd including Carmen Perry (ACIEEM), Matt Tennent, Lewis Hooper, Thomas Marceau, Joanne Gore, Tom Selby, Agatha Thompson (ACIEEM), Shannon Rae, Helen Gillooly, Alex Briggs, Timi Van Houten and Ellen Baugh as well as Tim Ferrero and Ellie Parker of Hampshire & Isle of Wight Wildlife Trust. Surveys were also assisted by Connor Reid of Natural England and Jessica Vagg and Sarah Chatfield of Chichester Harbour Conservancy. The number of surveyors

conducting surveys was proportionate to the size of the bed. Survey dates, number of surveyors and low tide times are provided in Table 1.

Table 1. Survey dates and timings

Date	Low Tide Time	Tide Height (m)	Number of Surveyors	Survey Location
09/08/2023	11:38	1.74	6 surveyors	East Portsmouth, Farlington
14/08/2023	16:33	1.74	4 surveyors	East Portsmouth, Farlington
25/08/2023	11:17	1.76	8 surveyors	Mengham Rithe, West Hayling
30/08/2023	17:05	0.94	2 surveyors	East Gosport, Portsmouth Harbour
01/09/2023	18:31	0.66	6 surveyors	Seagrove to Priory Bay, Isle of Wight
01/09/2023	18:06	0.61	2 surveyors	Norton Yarmouth, Isle of Wight
04/09/2023	08:05	0.37	2 surveyors	Needs Ore, Beaulieu
04/09/2023	08:05	0.37	4 surveyors	Calshot
06/09/2023	09:44	1.10	3 surveyors	Crake Rithe, Chichester Harbour
07/09/2023	10:37	1.82	2 surveyors	Fareham Lake, Portsmouth Harbour
07/09/2023	10:37	1.65	2 surveyors	Mengham Rithe, West Hayling
08/09/2023	12:15	2.28	6 surveyors	West Hayling, Langstone Harbour
11/09/2023	15:31	1.60	4 surveyors	East Head to Horse Pond
12/09/2023	16:09	1.46	3 surveyors	Yachthaven, East Hayling
22/09/2023	09:33	1.48	4 surveyors	Mill Rithe, Chichester Harbour
26/09/2023	15:06	1.61	2 surveyors	East Gosport, Portsmouth Harbour
26/09/2023	15:06	1.31	2 surveyors	Mill Rithe, Chichester Harbour

Date	Low Tide Time	Tide Height (m)	Number of Surveyors	Survey Location
27/09/2023	15:59	1.33	4 surveyors	West Hayling, Langstone Harbour
28/09/2023	16:40	0.73	3 surveyors	The Kench, Langstone Harbour
29/09/2023	17:20	0.66	3 surveyors	Gurnard, Isle of Wight

Biosecurity

Biosecurity procedures were followed to avoid the spread of INNS including guidelines for individuals, equipment and transportation, risk assessment and the principle of Check, Clean and Dry. The presence of significant INNS within or adjacent to seagrass beds were recorded if encountered, paying particular attention to Japanese wireweed *Sargassum muticum* and the Asian date mussel *Arcuatula senhousia* which has been recently found within seagrass at Ryde, Isle of Wight.

Data Analysis

GPS track files were saved in Keyhole Markup Language (.kml) or Geogrid-Viewer track log (.log). Tracks and photographs were submitted electronically using Locus Maps software and uploaded to ArcGIS software. All tracks/points gathered were then plotted and a polygon drawn based on the positive or negative tracks displayed to visualise habitat areas/seagrass beds. Field notes were also used to inform the digitisation process. Figures for seagrass beds were calculated using ArcGIS software, providing summary statistics by locality (multiple beds) and project area (all beds). ArcGIS was then used to obtain summary tables for the total areas of seagrass recorded within each Marine Protection Area (MPA).

Statistical analysis was used to determine any significant differences in extent, both by locality and overall. The statistical software R was used. The data consisted of paired samples taken at two different points in time: a measurement of seagrass bed area in the years 2019 and 2023. Only seagrass beds that have been fully surveyed in both years were included in the analysis. A paired t-test was used to compare the differences between the paired 2019 and 2023 measurements. This test determines whether the mean difference between the pairs of measurements is zero or not, thereby identifying whether seagrass bed size has changed between 2019 and 2023.

Constraints to survey

Practical issues were encountered during the surveys including poor visibility due to deep and turbid water as well as algae and seaweed cover obscuring seagrass beds. At some survey areas, low spring tides were sometimes too high for surveyors to reach or observe the previously mapped areas on foot due to reduced visibility and deep water. This included the seagrass beds at Lepe and Yarmouth as well as a small area by Bembridge. While the seagrass beds at Lepe were too far out for surveys to be conducted on foot, it was possible to reach the inland extent of the bed at Yarmouth, but due to deep low water and poor visibility, it was not possible to accurately note the characteristics of the bed or the outer extent.

It was not possible to access all of the areas that were intended to be surveyed. This included two areas in Portsmouth Harbour at Defence Munitions Gosport which presented a possible ordnance blast risk, and it was not possible to acquire access. In addition, Medina off of the Isle of Wight, was subject to numerous daily ferry crossings and it was not possible to gain access. There were also two areas within Chichester Harbour (Oar Rithe) that were inaccessible due to the presence of a large channel between these and the shore that could not be reached by foot, and it was not possible to acquire a boat within the time constraints. Within other areas surveyed, it was not always possible to access the full extent of the seagrass beds due to thick mud and deep, impassable channels.

Survey times were restricted to low tide times which provided a narrow survey window for most sites (up to two hours). However, it was possible to survey the majority of previously mapped areas within the survey window and notes were made on additional areas that should be surveyed in the future where it appears that the extent of seagrass has increased, but it was not possible to cover within the time constraints. Repeat visits were made to multiple sites to maximise survey coverage.

Due to time and tidal constraints, it was not possible to survey the whole seagrass bed at Farlington. However, the University of Portsmouth conducted drone surveys off Farlington in 2023 to map seagrass, which covered areas that our surveyors were not able to reach by foot. Therefore, this data should be gathered and incorporated in order to establish the current extent of this significant bed.

In addition, due to time constraints, large areas of “mosaic” beds, comprising many smaller patches, were mapped as single beds with the extent drawn around the entire group of patches. Therefore, it should be noted that in the statistical analysis, some areas included within the calculations would include sediment patches rather than a complete seagrass bed and consequently produce a slight overestimate of seagrass bed size. Therefore, caution should be exercised when interpreting the results of this data.

There were occasional issues with the GPS recording accuracy, likely due to limited satellite signal, which resulted in a number of tracks being slightly offset. This affected a limited number of points, mostly around Bembridge Point. Where this occurred, polygons were drawn manually on ArcGIS. This was carried out conservatively, drawing the

minimum size of the bed present based on field notes and using previous seagrass inventory data. Similarly, in order to allow for comparative analysis between survey years where data was limited, polygons were created following the previous seagrass inventory data to provide the minimum extent of bed coverage. The beds affected included Mill Rithe and West Hayling.

Due to the fact that only seagrass beds that have been surveyed in full in both years can be analysed, only 26 beds could be included within the statistical analysis. This included seagrass beds within Fareham Lake, Farlington, West Hayling, Yachthaven, Mill Rithe, Mengham Rithe, East Head, Crake Rithe, Itchenor, Gurnard, Priory Bay and Bembridge Point. Any seagrass beds that were not re-found, surveyed in full due to access restrictions, or new areas, were not included within the analysis.

Results

Seagrass was found in all areas surveyed where the beds were accessible. This included a mix of *Z. noltii*, *Z. marina* and *Z. marina* ecotype. All of the harbour sites (Portsmouth, Langstone and Chichester) comprised a substrate dominated by mud while the other sites were composed of a mix of sand, gravel and cobbles. A total seagrass bed coverage of 251.18ha was recorded across the areas surveyed within the Solent and Isle of Wight. Beds consisting of a mix of *Z. noltii* and *Z. marina* ecotype made up approximately 40% of this total area, covering 101.04ha, closely followed by mixed beds of *Z. noltii* and *Z. marina* which covered a total area of 88.05ha (35% of all seagrass beds recorded).

Coverage of seagrass across the survey areas was largely similar to previous years survey data, however, there were notable expansions and contractions of beds. In addition, new areas were observed and mapped which had not been included in the seagrass inventory previously. This included a new seagrass bed at Fareham Lake off the coast of Porchester, and new beds within Mill Rythe and the Kench around Hayling Island. Where possible and available, data from previous surveys is included within the summary tables alongside data collected in 2023.

Seagrass density was variable across the survey locations ranging from very dense beds in places to sparse and patchy areas. Algae was widespread across the sites and there were multiple signs of anthropogenic pressures in the beds including gauges/dredge marks, significant pollution and discolouration of mud due to unknown causes. However, no non-native species or pathogens were observed at any of the sites. Comparisons were made with data from previous surveys of these seagrass beds where possible. Initial findings from surveys have found that the extent of seagrass in the Solent has increased at a number of survey locations, despite some small contractions in range at others. Additional seagrass beds were found that had not been surveyed previously.

Needs Ore, Beaulieu, East Solent

Seagrass extent, composition and condition

Needs Ore is located within the Solent Maritime SAC. Only negative tracks were gathered at Needs Ore in 2023 due to deep low water and poor visibility. As a result, surveyors were not able to reach the beds. Bait diggers were observed in the vicinity and may have an adverse impact on seagrass beds. There were no signs of non-native species and pathogens or algal growth, however it was not possible to reach the bed to confirm this.

Comparison with previous years

No comparison was possible as seagrass beds were not accessed in 2023.

Recommendations for further survey

The beds are too deep for intertidal methods to be employed. Therefore, it is recommended that this area is re-surveyed in the future using an alternative survey method such as by drone, boat, scuba diving and/or waterproof handheld camera to assess the extent and condition of seagrass at this location.

Calshot, East Solent

Seagrass extent, composition and condition

The seagrass bed at Calshot is dominated by *Z. marina* on a sand substrate (Photograph 1) with just a small patch of *Z. noltii* along the western edge. It was not possible to gather an accurate determination of seaward extent by wading due to deep water and poor visibility, but it is thought the bed extends substantially into the subtidal area. Where seagrass was observed, density varied from sparse patches of approximately 25% coverage within a quadrat up to 95% coverage. Small amounts of algal growth were observed. There were no signs of anthropogenic pressures, non-native species or pathogens, however, visibility was limited.

A summary of the seagrass beds including comparison can be found in Table 2 (previous seagrass inventory data included for comparison).

Comparison with previous years

The entire outer extent was also not fully assessed in previous surveys although a total area of 42.58ha was mapped (Marsden and Chesworth, 2015). However, it appears that the bed has extended slightly in some areas, with more seagrass being recorded nearer the shore than in previous years. In addition, it extends further to the south and it likely extends further to areas where surveyors were unable to access in 2023 due to time and tide constraints. An additional area was mapped in 2023 and comprises a bed of approximately 5ha to the north of the main beds. This is a *Z. marina* bed that becomes patchier further north.

Recommendations for further survey

Due to time and tidal constraints, it was not possible to survey the entire stretch along Calshot and, as per previous surveys, it was not possible to survey the outer extent of the bed. Therefore, this area should be surveyed using an alternative survey method such as surveying by drone, boat, scuba diving and/or waterproof handheld camera to assess the extent and condition of seagrass at this location, as the beds are too deep for intertidal methods to be employed.

Table 2. Seagrass survey data summary

Designation	Solent & Southampton Water SPA and Ramsar	Solent & Southampton Water SPA and Ramsar
Year	2023	Previous data (2013)
Species	*Z. marina*, one small patch of *Z. noltii*	*Z. marina* and *Z. noltii*
Approx. size of bed (ha)	Unable to survey full extent Area surveyed: 27.66	42.58
Density range (% cover)	25-95	Patchy to dense
Average density (%)	55.83	Not specified
Sediment composition and distribution	Sand	Not specified
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	None observed	Damage by bait digging

Fareham Lake, Cams Bay, Portsmouth Harbour

Seagrass extent, composition and condition

The seagrass beds comprise a mix of *Z. noltii* and *Z. marina* on mud with some gravel (Table 3a). Density is variable throughout with very dense beds in places as well as patchier areas such as along the northern edge where the *Z. noltii* and *Z. marina* bed becomes sparser. The seagrass beds to the east of Pewit Island are mostly *Z. marina* with some *Z. noltii* to the south-east. It was difficult to observe some areas due to thick layers of algae covering the bed, particularly on the south and south-west edges (Photographs 2 and 3). Anthropogenic pressures were observed with signs of pollution in the water as well as large gauges/dredge marks extending across the mud, possibly from boats/equipment being dragged through (Photograph 4). Seagrass extends further eastwards which was not recorded during this survey due to time constraints.

An additional area was surveyed off the coast of Fareham just to the south-west of the area described above, following reports of seagrass observations (Table 3b). This is a

large area in Wicor Lake to the south of Porchester. The bed comprised mostly dense *Z. noltii* with *Z. marina* ecotype towards the south-east by the channel. The centre of the bed is sparser with large areas that contained no seagrass, as well as areas with only small patches. Seagrass was noted to extend further eastwards and north-west but was not recorded during this survey due to time constraints. In addition, to the south-west there are a number of small discrete patches of seagrass, not forming a continuous bed but extending further seawards.

No non-native species and pathogens were observed at either site.

A summary of the seagrass beds can be found in Tables 3a and 3b (previous seagrass inventory data included for comparison).

Table 3a. Seagrass survey data summary – existing beds

Designation	Portsmouth Harbour SSSI, SPA and Ramsar	Portsmouth Harbour SSSI, SPA and Ramsar
Year	2023	Previous data (2014)
Species	*Z. noltii* and *Z. marina*	*Z. noltii, Z. marina* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	28.20	11.64
Density range (% cover)	30-80	Patchy to dense
Average density (%)	51.25	Not specified
Sediment composition and distribution	Mud with some gravel on western edge	Mud
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	Algae present in abundance	Algae present in abundance in several areas
Anthropogenic pressures	Gauges/dredge marks in mud possibly from boats/equipment being dragged through Pollution	Dredging and trampling damage

Table 3b. Seagrass survey data summary – new area (no previous survey data available)

Designation	Portsmouth Harbour SSSI, SPA and Ramsar
Species	*Z. noltii, Z. marina* and *Z. marina* ecotype
Approx. size of bed (ha)	16.98
Density range (% cover)	10-100
Average density (%)	51.00
Sediment composition and distribution	Mud with some gravel
Non-native species and pathogens	None observed
Water quality (algal growth)	Patchy algae growth
Anthropogenic pressures	Marine litter

Comparison with previous years

The seagrass bed to the east of Pewit Island appears to be similar in size to that surveyed previously. However, the other seagrass beds surveyed have increased in size with a total area of 28.20ha mapped in 2023 compared to 11.64ha during previous surveys in 2014. In particular, there is more seagrass by the shore towards Porchester while the bed to the south-east of Pewit Island has more than doubled in size, expanding in all directions. It is possible that the beds also extend further southwards away from the shore as well as to the east of Wicor Lake. However due to large channels and time constraints, it was not possible to survey further.

According to the previous survey report (Marsden and Chesworth, 2015) substantial dredging activity was first recorded here in 2009. The beds appeared to be recovering by 2013 with the eastern drainage channel banks being smoother and unpitted, though still very soft. It appears that the area is still quite heavily used and subject to anthropogenic pressures, although potentially not as much as it has been previously.

Recommendations for further survey

It was not possible to map the full extent of the new seagrass beds within this survey programme due to time constraints, incoming tides and deep mud. Therefore, further surveys are recommended, using an alternative survey method, if required, to assess the full extent of these additional areas.

Farlington, Portsmouth Harbour

Seagrass extent, composition and condition

Due to time constraints, it was not possible to survey the whole seagrass bed at Farlington. Therefore, only the inland areas to the north were surveyed and mapped. The University of Portsmouth conducted drone surveys off Farlington in 2023 to map seagrass, which covered areas that surveyors on foot were not able to access. The beds surveyed comprise a mix of *Z. noltii* and *Z. marina* on mud. Towards the southern edge of the bed there is a greater abundance of *Z. marina* ecotype. Density of seagrass was variable with some denser patches of up to 100% coverage (Photograph 5), particularly towards the north-east edge, whereas plants were more scattered further west. Algae is present in varying levels of abundance with some quadrats having little or no algae and others some containing thick mats where it was difficult to accurately record seagrass coverage beneath. No signs of anthropogenic pressures, non-native species or pathogens were observed.

A summary of the seagrass beds can be found in Table 4 (previous seagrass inventory data included for comparison).

Comparison with previous years

The extent of seagrass at Farlington in the areas surveyed has increased from previous years with expansions in all directions forming multiple larger continuous beds rather than smaller isolated patches which were recorded previously. Areas were not directly comparable with the previous dataset as slightly different areas were surveyed

Recommendations for further survey

Data from drone surveys undertaken by the University of Portsmouth should be obtained and collated with that gathered from these surveys to assess the full extent of seagrass at Farlington.

Table 4. Seagrass survey data summary

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Year	2023	Previous data (2014)
Species	*Z. noltii, Z. marina* and *Z. marina* ecotype	*Z. noltii* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	Unknown - unable to survey full extent Area surveyed: 2.49	0.71 - not directly comparable as different areas were surveyed
Density range (% cover)	10-100	Dense
Average density (%)	47.08	Not specified
Sediment composition and distribution	Mud	Muddy sand and mud
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	None observed	None observed

The Kench, West Hayling

Seagrass extent, composition and condition

The seagrass beds at the Kench were not included in the 2006-2018 Seagrass Inventory, however, there have been reports of beds at this location. Both *Z. noltii* and *Z. marina* were recorded with the former being more abundant. There are dense patches of *Z. noltii* of up to 75% coverage within the southern part of the Kench while to the north-east, there is a mix of *Z. noltii* and *Z. marina* ecotype. Seagrass is more abundant towards the shore becoming patchier in distribution further seawards. There is a wide, impassable channel to the north of the survey area but there appears to be further areas of seagrass the other side of this (Photograph 6). No signs of anthropogenic pressures or non-native species and pathogens were observed, and just small amounts of algae were present.

A summary of the seagrass beds can be found in Table 5.

Table 5. Seagrass survey data summary (no previous survey data available)

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Species	*Z. noltii, Z. marina* and *Z. marina* ecotype
Approx. size of bed (ha)	4.69
Density range (% cover)	1-75
Average density (%)	39.50
Sediment composition and distribution	Mud and gravel/sand
Non-native species and pathogens	None observed
Water quality (algal growth)	Low abundance of algae present
Anthropogenic pressures	None observed

Comparison with previous years

No previous survey data have been gathered for this site in order to make comparisons.

Recommendations for further survey

As this is the first year of mapping seagrass in this area, it is recommended that further surveys are conducted to monitor the extent and distribution of beds at this location. Areas of seagrass were observed further north-east beyond the channels that were not accessible on foot during the 2023 surveys. Additional survey methods such as surveying by drone, boat, scuba diving and/or waterproof handheld camera could be employed to assess the full extent of seagrass beds.

West Hayling, Langstone Harbour

Seagrass extent, composition and condition

The beds at West Hayling consisted mostly of *Z. noltii* with occasional small patches of *Z. marina* on mud. The latter was found in small patches along the northern edge of the bed with additional patches along the south-west seaward edge. While the entirety of the inland extent was walked, seagrass extended westwards but it was not possible to walk

out further due to numerous deep channels, thick mud and high water levels. Seagrass was also present within the channels (Photograph 7). Density was variable with denser beds of up to 95% coverage within quadrats and patchy areas of seagrass interspersed with bare mud and algae. Algae was present across much of the bed with occasional particularly dense areas towards the centre as well as patches of seaweed. Water clarity was reduced towards the centre of the bed and the mix of silt and very dense patches of algae made it difficult to observe the seagrass in places. No signs of anthropogenic pressures or non-native species and pathogens were observed.

A summary of the seagrass beds can be found in Table 6 (previous seagrass inventory data included for comparison).

Table 6. Seagrass survey data summary

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2014)
Species	*Z. noltii* and *Z. marina*	*Z. noltii* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	Unknown - unable to survey full extent Area surveyed: 38.58	76.47
Density range (% cover)	5-95	Dense
Average density (%)	47.95	Not specified
Sediment composition and distribution	Mud	Muddy sand and mud
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	None observed	None observed

Comparison with previous years

It was not possible to access and survey the entirety of the seagrass bed at West Hayling, particularly the seaward edge, and therefore not possible to compare with previous surveys. However, the entire inland edge was walked and allows for comparison. It seems that the extent of seagrass is similar to previous years; there is a slight contraction along the northern edge however it has expanded in range at the southern edge and can be found closer to the shoreline than in previous surveys.

Recommendations for further survey

Seagrass extended further west than surveyors could access on foot during the 2023 surveys due to time and tide constraints and wide, impassable channels. It is recommended that areas that surveyors were unable to reach are surveyed in the future using an alternative survey method such as surveying by drone, boat, scuba diving and/or waterproof handheld camera to assess the extent and condition of seagrass at this location.

Mengham Rithe, East Hayling

Seagrass extent, composition and condition

The beds at Mengham Rithe are dominated by *Z. noltii* with smaller amounts of *Z. marina* and *Z. marina* ecotype, mostly in discrete patches, although there were some mixed beds along the southern edge. Density is variable ranging from 10% to 100% coverage, but it was predominately found in dense patches and only occasional areas of sparsely distributed plants. Along the western edge, *Z. noltii* is mostly restricted to the channels rather than being found on the surface of the mud above water level. There is dense algal growth across the bed and occasional patches of seaweed as well as signs of anthropogenic pressures including gauges/dredge marks in mud, possibly from boats/equipment being dragged through (Photograph 8). No non-native species and pathogens were recorded.

It was not possible to access the northernmost area that was surveyed in previous years due to a large channel (the Mengham Rithe) separating it from the other survey areas and no access to the north from the Tournerbury Woods Estate and golf course.

A summary of the seagrass beds can be found in Table 7 (previous seagrass inventory data included for comparison).

Comparison with previous years

As surveyors were unable to access the entire northernmost area, it was not possible to include this for comparison. Therefore, the survey areas are not directly comparable, and the size of the bed recorded in 2023 was only 33.33ha compared to 46.5ha in 2013.

There appears to be a greater extent of seagrass in the southern part of Mengham Rithe than recorded in the previous surveys. Here seagrass was observed further eastwards almost up to the marina, as well as further up the channel to the west and towards the shore to the south. The northern and western edges of the larger bed also extends slightly further than in previous years.

Table 7. Seagrass survey data summary

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2013)
Species	*Z. noltii, Z. marina* and *Z. marina* ecotype	*Z. noltii* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	Unknown - unable to survey full extent Area surveyed: 33.33	46.5
Density range (% cover)	10-100	Dense
Average density (%)	68.90	Not specified
Sediment composition and distribution	Mud, stones and cobbles	Muddy sand and mud
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	Gauges/dredge marks in mud possibly from boats/equipment being dragged through	Holes in seagrass beds due to dragging mooring chains

Recommendations for further survey

Since it was not possible to survey the northernmost area, it is recommended that this area is surveyed in the future to assess the extent and condition of seagrass at this

location. This can either by conducted on foot by acquiring access from the Tournerbury Woods Estate and golf course, or by alternative survey methods such as drone, boat, scuba diving and/or waterproof handheld camera.

Mill Rithe, East Hayling

Seagrass extent, composition and condition

Mill Rithe comprises seagrass beds of *Z. noltii* and *Z. marina* ecotype that extend seaward a short way beyond the previously mapped extent. There are a lot of channels within the beds, particularly close to the shore, and some contain seagrass as well as beds of cordgrass *Spartina* and glasswort *Salicornia* throughout. These channels limited surveyor ability to access the full extent of the beds. It is not a consistent bed with *Z. noltii* interspersed with large patches of bare mud but some dense, continuous meadows are present, and particularly abundant within the channels throughout the survey area. However, there is a lot of seaweed cover in places which made it difficult to accurately record seagrass density (Photograph 9). Algal growth was also found across the bed. There were no signs of anthropogenic pressures or non-native species and pathogens.

A summary of the seagrass beds can be found in Table 8 (previous seagrass inventory data included for comparison).

Comparison with previous years

The seagrass beds at Mill Rithe have largely maintained their extent, expanding slightly on the eastern edge and towards the main channel. There are additional beds to the west towards Yachthaven as well as small patches at the northern end around the channels. However, it was not possible to access the entirety of the beds in order to provide full comparative analysis, and previous datasets were used in 2023 to complete the mapping of seagrass extent.

Recommendations for further survey

It is recommended that further surveys are conducted to monitor the full extent and distribution of seagrass at this location. Additional survey methods such as surveying by drone, boat, scuba diving and/or waterproof handheld camera could be employed to provide a more comprehensive overview on the beds and are not limited by tide and time constraints.

Table 8. Seagrass survey data summary

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2013)
Species	*Z. noltii* and *Z. marina* ecotype	*Z. noltii, Z. agustifolia (Z. marina* ecotype) and *Ruppia* sp.
Approx. size of bed (ha)	59.89	52.09
Density range (% cover)	20-100	Patchy to sparse
Average density (%)	68.82	Not specified
Sediment composition and distribution	Mud	Muddy sand and soft mud
Non-native species and pathogens	None observed	Not specified
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	None observed	Not specified

Yachthaven, East Hayling

Seagrass extent, composition and condition

There are large seagrass beds within the channel at Yachthaven consisting mostly of *Z. noltii* with *Z. marina* and *Z. marina* ecotype in lower levels of abundance, found scattered throughout. Density is variable ranging from very dense beds to sparse and patchy seagrass of approximately 5% coverage. There is an abundance of algae mixed with seaweed, particularly in the northern bed, which reduced the visibility of seagrass and therefore made it difficult to accurately determine density across numerous quadrats, so this was estimated. In addition, numerous smaller channels throughout the survey area made some patches of seagrass/beds inaccessible, such as to the east where it appeared that the beds extended further past the channels. There are signs of anthropogenic pressure including pollution and damage by boats and equipment being dragged through the mud, leaving deep gauges/dredge marks. However, no non-native species and pathogens were observed.

A summary of the seagrass beds can be found in Table 9 (previous seagrass inventory data included for comparison).

Table 9. Seagrass survey data summary

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2013)
Species	*Z. noltii, Z. marina* and *Z. marina* ecotype	*Z. noltii, Z. agustifolia (Z. marina* ecotype) and *Ruppia* sp.
Approx. size of bed (ha)	11.66	6.56
Density range (% cover)	5-100	Patchy to sparse
Average density (%)	56.4	Not specified
Sediment composition and distribution	Mud	Muddy sand and soft mud
Non-native species and pathogens	None observed	Not specified
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	Gauges/dredge marks in mud possibly from boats/equipment being dragged through	Holes in seagrass beds due to dragging mooring chains

Comparison with previous years

The extent of seagrass has increased since previous surveys in all areas of Yachthaven, expanding right up the channels and nearer to the shore. A total area of 6.56ha was recorded in 2013 whereas 11.66ha was observed in 2023. In addition, a new large bed was recorded to the south, between the channel and shore up to the marina at Hayling Yacht Company. No *Ruppia* sp. was observed during the 2023 surveys. This is likely to be due to the fact that this is mostly a subtidal species whereas all the 2023 surveys only covered the intertidal zones.

Recommendations for further survey

Additional areas of seagrass were noted, however, it was not possible to survey them in their entirety in 2023 due to time, tide and access constraints. Further surveys are recommended, using an alternative survey method if required, to assess the full extent of seagrass beds and expansion of its range.

Crake Rithe, Chichester Harbour

Seagrass extent, composition and condition

Crake Rithe comprised a mixed bed of mostly *Z. noltii* with some *Z. marina* and *Z. marina* ecotype in lower levels of abundance and interspersed throughout. The substrate is predominantly mud with a small amount of gravel. The seagrass was mostly dense; 80-100% coverage in multiple quadrats with sparser areas where only a few scattered plants were recorded, particularly at the edges and to the south-west. There are multiple patches of dense algae covering the seagrass as well as areas of very dark and discoloured mud which are thought to be due to anthropogenic pressures (Photographs 10 and 11). No non-native species and pathogens were observed.

A summary of the seagrass beds can be found in Table 10 (previous survey data included for comparison).

Comparison with previous years

Crake Rithe was last surveyed by HIWWT in 2015 (Marsden and Chesworth, 2015). The approximate distribution of seagrass in 2023 appears very similar to the previous surveys but has extended slightly, particularly to the north and south. However, it has also contracted in range along the north-western edge. A total of 8.63ha was recorded in 2013 compared to 9.80ha in 2023. No *Ruppia* sp. was observed during the 2023 surveys. This is likely to be due to the fact that this is mostly a subtidal species whereas all the 2023 surveys only covered the intertidal zones.

Recommendations for further survey

Additional areas of seagrass not previously mapped were identified during the 2023 surveys, however due to time constraints within the survey programme, it was not possible to survey them. These are located to the north of the survey area and separated from it by a large channel. Further surveys are recommended to assess the full extent of this, as well as further west to establish if seagrass has completely contracted along this edge or can still be found further out but just become patchy in distribution. This can be conducted by foot or alternative survey methods such as surveying by drone, boat, scuba diving and/or waterproof handheld camera.

Table 10. Seagrass survey data summary

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2013)
Species	*Z. noltii, Z. marina* and *Z. marina* ecotype	*Z. noltii, Z. agustifolia (Z. marina* ecotype) and *Ruppia* sp.
Approx. size of bed (ha)	9.80	8.63
Density range (% cover)	5-100	10-80
Average density (%)	49.35	Not specified
Sediment composition and distribution	Mud, a small amount of gravel	Muddy sand and soft mud
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	Patches of thick algal growth present	Not specified
Anthropogenic pressures	Discoloured mud of unknown causes	Not specified

Horse Pond to East Head, Chichester Harbour

Seagrass extent, composition and condition

The seagrass bed off the coast of Itchenor comprised *Z. noltii* beds with some *Z. marina* ecotype towards the shoreward extent (Table 11a). There are additional patches of *Z. noltii* along the western edge that extend further westwards, however, it was not possible to survey further due to time and tide constraints. Algae is present in mostly low levels of abundance across the bed with occasional denser mats. There are some signs of anthropogenic pressures including damage from boats such as gauges/dredge marks in the mud, as well as some areas of discoloured, black mud and some dead seagrass plants.

The seagrass bed off of East Head, West Wittering, comprises a mix of largely *Z. noltii* with *Z. marina* that is located on the edge of saltmarsh (Table 11b). Seagrass becomes sparser and patchier at the northern end as this is where *Z. marina* is mostly found in low levels of abundance. Signs of pollution were noted and there is an abundance of algae as well as occasional patches of seaweed. Further areas of seagrass were observed to the west and within channels, however, it was not possible to survey further due to time and tide constraints.

No non-native species and pathogens were observed.

A summary of the seagrass beds can be found in Tables 11a and 11b (previous seagrass inventory data included for comparison).

Table 11a. Seagrass survey data summary – Itchenor

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2013)
Species	*Z. noltii* and *Z. marina* ecotype	*Z. noltii* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	4.91	3.65
Density range (% cover)	10-95	Dense to patchy and sparse
Average density (%)	57.22	Not specified
Sediment composition and distribution	Mud	Muddy sand and soft mud
Non-native species and pathogens	None observed	Not specified
Water quality (algal growth)	Algae present	Algae present
Anthropogenic pressures	Signs of damage from boats Discoloured mud Some dead seagrass plants	Not specified

Table 11b. Seagrass survey data summary – East Head

Designation	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar	Langstone Harbour SSSI, Solent Maritime SAC and Chichester and Langstone Harbours SPA and Ramsar
Date	2023	Previous data (2013)
Species	*Z. noltii* and *Z. marina*	*Z. noltii* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	9.96	4.05
Density range (% cover)	10-90	Patchy to sparse
Average density (%)	65	Not specified
Sediment composition and distribution	Mud	Muddy sand and soft mud
Non-native species and pathogens	None observed	Not specified
Water quality (algal growth)	Algae present	Algae present
Anthropogenic pressures	Signs of pollution	Not specified

Comparison with previous years

The extent of seagrass at Itchenor is largely the same as in previous years, with small contractions and expansions in range along the survey area. Overall, it appears that there are more new areas of seagrass than reductions in range, particularly to the north and east where it appears to have spread inland towards the shore and along channels. The seagrass also extends into the channel on the western edge, potentially further west into subtidal areas that have not been previously surveyed and was not possible to access in 2023. A total of 3.65ha was recorded in 2013 compared to 4.91ha in 2023.

The extent of seagrass at the southern end of East Head is largely the same as in previous years surveys, however, its extent has increased significantly northwards with patches of both *Z. noltii* and *Z. marina* observed. The seagrass also extends into the channel on the western edge, potentially further west but was not possible to access due to time and tide constraints. The total area has more than doubled in size with 4.05ha recorded in 2013 compared to 9.96ha in 2023.

Recommendations for further survey

Additional areas of seagrass were noted further to the west of Itchenor and East Head. However due to time constraints, it was not possible to survey them in their entirety in 2023. Further surveys are recommended to assess the full extent of this, to establish how far seagrass has expanded in range. This could be conducted by foot or by using alternative survey methods such as surveying by drone, boat, scuba diving and/or waterproof handheld camera.

Yarmouth, Isle of Wight

Seagrass extent, composition and condition

Yarmouth is located within the Solent Maritime SAC. Low spring tides were too high for surveyors to observe the previously mapped areas on foot due to reduced visibility and deep water. This included the seagrass bed at Yarmouth; while it was possible to reach the inland extent of the bed at Yarmouth, due to deep low water and poor visibility, it was not possible to accurately note the characteristics of the bed or the outer extent. From what could be observed, there were no signs of non-native species and pathogens or algal growth, however it was not possible to fully survey the bed to confirm this.

Comparison with previous years

No comparison was possible as seagrass beds were not surveyed in full in 2023.

Recommendations for further survey

The beds are too deep for intertidal methods to be employed. Therefore, it is recommended that this area is re-surveyed in the future using an alternative survey method such as by drone, boat, scuba diving and/or waterproof handheld camera to assess the extent and condition of seagrass at this location.

Gurnard, Isle of Wight

Seagrass extent, composition and condition

Beds of *Z. marina* were observed at Gurnard. However, there was deep water and poor visibility and therefore, it was not possible to walk around the full extent of the bed and survey the entirety of the previously mapped area. However, the entire shoreward extent was surveyed, and points made for seagrass presence. Density was low for most of the bed with very sparse stands and occasional plants at the eastern end developing into slightly denser patches towards the western extent, but no more than 40% coverage was observed. There were no signs of anthropogenic pressures, non-native species and pathogens or algal growth, however visibility was limited.

A summary of the seagrass beds can be found in Table 12 (previous seagrass inventory data included for comparison).

Table 12. Seagrass survey data summary

Designation	Solent Maritime SAC; Marine Conservation Zone (MCZ) (Yarmouth to Cowes: UKMCZ0075)	Solent Maritime SAC; Marine Conservation Zone (MCZ) (Yarmouth to Cowes: UKMCZ0075)
Date	2023	Previous data (2010)
Species	*Z. marina*	*Z. marina*
Approx. size of bed (ha)	Unknown - unable to survey full extent Area surveyed: 0.84	0.36
Density range (% cover)	1-40	Not specified
Average density (%)	11.6	Not specified
Sediment composition and distribution	Sand and pebbles/rocks	Clay, occasionally sand
Non-native species and pathogens	None observed	None observed
Water quality (algal growth)	None observed	None observed
Anthropogenic pressures	None observed	None observed

Comparison with previous years

It was not possible to access and survey the entirety of the seagrass bed at Gurnard, only the shoreward extent, and therefore not possible to compare with previous years surveys.

Recommendations for further survey

It is recommended that this area is re-surveyed in the future using an alternative survey method such as surveying by drone, boat, scuba diving and/or waterproof handheld camera to assess the extent and condition of seagrass at this location as the beds are too deep for intertidal methods to be employed.

Seagrove to Priory Bay and Bembridge, Isle of Wight

Seagrass extent, composition and condition

Two small *Z. marina* plants were recorded at the northern end of Seagrove Bay (Photograph 12). No other areas of seagrass were observed here. However, at Priory Bay, it appears that seagrass has largely maintained its extent and dominated by *Z. marina* with *Z. noltii* at the southern edge (Table 13a). Density is variable across the bed with some very dense patches mixed with sparser areas and occasional individual plants.

Only a small area of the seagrass bed off Bembridge Bay could be accessed; *Z. marina* was found here as well as to the east of Bembridge (Table 13b). Density was also variable ranging from some dense beds particularly to the south, to patchier distributions of seagrass but no less than 30% coverage was recorded. Seagrass appeared to extend further north-east, however, it was not possible to access these areas in 2023.

At Bembridge Point, beds also comprised solely of *Z. marina* and density was variable but with numerous dense patches where several quadrats contained 100% density (Table 13c). In addition, there were a couple of small areas where there were dead seagrass plants, of unknown causes. Otherwise, there were no signs of anthropogenic pressures, non-native species and pathogens, although algal growth was found within all seagrass beds between Seagrove and Bembridge.

A summary of the seagrass beds can be found in Tables 13a-c (previous seagrass inventory data included for comparison).

Comparison with previous years

Seagrass beds that were mapped previously at Seagrove Bay by HIWWT in 2015 were not found again in 2023; only two small *Z. marina* plants were recorded at the northern end of Seagrove Bay. A smaller coverage of seagrass was also observed at Priory Bay where range has reduced along the eastern edge, despite surveyors being able to walk out to assess the boundaries of the previous extent. A total of 0.95ha was observed in 2014 while only 0.31ha was recorded in 2023. There appears to be a reduction in extent around Bembridge Harbour and Seaview, however, this may be due to inabilities to access all areas that were previously surveyed. Therefore, it is not possible to make direct comparisons. Additional survey methods were carried out previously including snorkelling and scuba diving (Marsden and Chesworth, 2015).

Recommendations for further survey

Due to time and tidal constraints, it was not possible to survey the entire stretch to the east of Bembridge as well as to the north of Spring Vale, and therefore further surveys are recommended to complete these areas. Additional areas of seagrass extended further out from Bembridge Bay than surveyors were able to access. Further surveys are

recommended, using an alternative survey method such as surveying by drone, boat, scuba diving and/or waterproof handheld camera as required, to assess the full extent.

Table 13a. Seagrass survey data summary – Priory Bay

Designation	Solent & Southampton Water SPA and Ramsar and Brading Marshes to St Helen's Ledges SSSI; MCZ (Bembridge: UKMCZ0054)	Solent & Southampton Water SPA and Ramsar and Brading Marshes to St Helen's Ledges SSSI; MCZ (Bembridge: UKMCZ0054)
Date	2023	Previous data (2014)
Species	*Z. noltii* and *Z. marina*	*Z. noltii* and *Z. marina*
Approx. size of bed (ha)	0.31	0.95
Density range (% cover)	5-100	Not specified
Average density (%)	45.9	Patchy to 100% cover in some places
Sediment composition and distribution	Sand	Sandy with occasional patches of pebbles
Non-native species and pathogens	None observed	*Sargassum muticum* recorded in patches and up to 70% coverage
Water quality (algal growth)	Algae present	Evidence of storm damage
Anthropogenic pressures	None observed	Not specified

Table 13b. Seagrass survey data summary – Bembridge Bay

Designation	Solent & Southampton Water SPA and Ramsar, South Wight Maritime SAC and Whitecliff Bay and Bembridge Ledges SSSI; MCZ (Bembridge: UKMCZ0054)	Solent & Southampton Water SPA and Ramsar, South Wight Maritime SAC and Whitecliff Bay and Bembridge Ledges SSSI; MCZ (Bembridge: UKMCZ0054)
Date	2023	Previous data (2014)
Species	*Z. marina*	*Z. noltii* and *Z. marina*
Approx. size of bed (ha)	Unable to survey full extent Area surveyed: 1.03	6.75
Density range (% cover)	30-100	Not specified
Average density (%)	70	Patchy to 100% cover in some places
Sediment composition and distribution	Pebbles and gravel with some sand	Sandy with occasional patches of pebbles
Non-native species and pathogens	None observed	*Sargassum muticum* recorded in patches and up to 70% coverage
Water quality (algal growth)	Algae present	Evidence of storm damage
Anthropogenic pressures	None observed	Aggregate extraction activity close to beds

Table 13c. Seagrass survey data summary – Bembridge Point

Designation	Solent & Southampton Water SPA and Ramsar, South Wight Maritime SAC and Whitecliff Bay and Bembridge Ledges SSSI; MCZ (Bembridge: UKMCZ0054)	Solent & Southampton Water SPA and Ramsar, South Wight Maritime SAC and Whitecliff Bay and Bembridge Ledges SSSI; MCZ (Bembridge: UKMCZ0054)
Date	2023	Previous data (2014)
Species	*Z. marina*	*Z. noltii, Z. marina* and *Z. agustifolia (Z. marina* ecotype)
Approx. size of bed (ha)	Unable to survey full extent Area surveyed: 0.86	2.17
Density range (% cover)	0-100	>70%
Average density (%)	67.14	Patchy to 100% cover in some places
Sediment composition and distribution	Sand	Sandy with occasional patches of pebbles
Non-native species and pathogens	None observed	Extensive *Sargassum muticum*
Water quality (algal growth)	Algae present	Not specified
Anthropogenic pressures	None observed, some dead seagrass of unknown cause	None observed

Summary

Seagrass Area within Marine Protection Areas

The Solent waterbody is composed of a myriad of designated sites. Seagrass was recorded across 18 designated sites within the Solent and Isle of Wight including SSSIs, SPAs, SACS, Ramsars and MCZ. Analysis was undertaken to determine the total hectares of seagrass recorded within each MPA. The majority was found within SSSIs and Ramsar sites with a total of 228.48ha of seagrass in these areas while MCZs had the smallest seagrass beds within the survey areas with a total of 23.02ha observed. Table 14 details the total areas of seagrass beds found within each of the MPAs in the survey area while Table 15 provides a summary of total seagrass area per designated site type.

It should be noted that large areas of “mosaic” beds, comprising many smaller patches, were mapped as single beds with the extent drawn around the entire group of patches. Therefore, some areas included within the total areas would include sediment patches rather than a complete seagrass bed and consequently produce a slight overestimate of seagrass bed area. Caution should be exercised when interpreting the results of this data.

Table 14. Seagrass areas within the MPAs

Designated Site	Site Name	Seagrass Area (ha)
SSSI	Chichester Harbour	129.55
SSSI	Langstone Harbour	45.75
SSSI	Portsmouth Harbour	44.00
SSSI	North Solent	7.77
SSSI	Brading Marshes to St. Helen's Ledges	0.55
SSSI	Whitecliff Bay and Bembridge Ledges	0.86
SPA	Solent and Dorset Coast	66.67
SPA	Solent & Southampton Water	9.18
SPA	Portsmouth Harbour	45.16
SPA	Chichester and Langstone Harbours	175.30

Designated Site	Site Name	Seagrass Area (ha)
SAC	Solent Maritime	176.15
SAC	South Wight Maritime	0.86
Ramsar	Solent & Southampton Water	9.18
Ramsar	Portsmouth Harbour	44.00
Ramsar	Chichester and Langstone Harbours	175.30
MCZ	Bembridge	2.20
MCZ	Fareham Creek	19.98
MCZ	Yarmouth to Cowes	0.84

Table 15. Seagrass summary within the MPAs

Designated Site	Seagrass Area (ha)
SSSI	228.48
SPA	121.02
SAC	177.00
Ramsar	228.48
MCZ	23.02

Statistical Analysis of Datasets

The 2019 and 2023 seagrass bed measurements were not normally distributed when plotted on histograms and when tested using the Shapiro-Wilk test for normality (2019 data: $W=0.504$, $p<0.05$; 2023 data: $W=0.620$, $p<0.05$). The data was retested using the Shapiro-Wilk test after undergoing a log transformation which reported that the data now fitted a normal distribution (2019 data: $W=0.952$, $p = 0.260$; 2023 data: $W=0.978$, $p=0.819$). There was also no significant difference between the variances of the samples, so a paired t-test was carried out.

The average seagrass bed size significantly increased between 2019 and 2023 (t=-3.398, p<0.05) from 3.89ha to 5.08ha, with a total area of 101.12ha in 2019 compared to 132.13ha in 2023. This is an increase of 31%, as shown in Figure 1. It should be noted that large areas of “mosaic” beds, comprising many smaller patches, were mapped as single beds with the extent drawn around the entire group of patches. Therefore, some areas included within the calculations would include sediment patches rather than a complete seagrass bed and consequently produce a slight overestimate of seagrass bed size. Caution should be exercised when interpreting the results of this data.

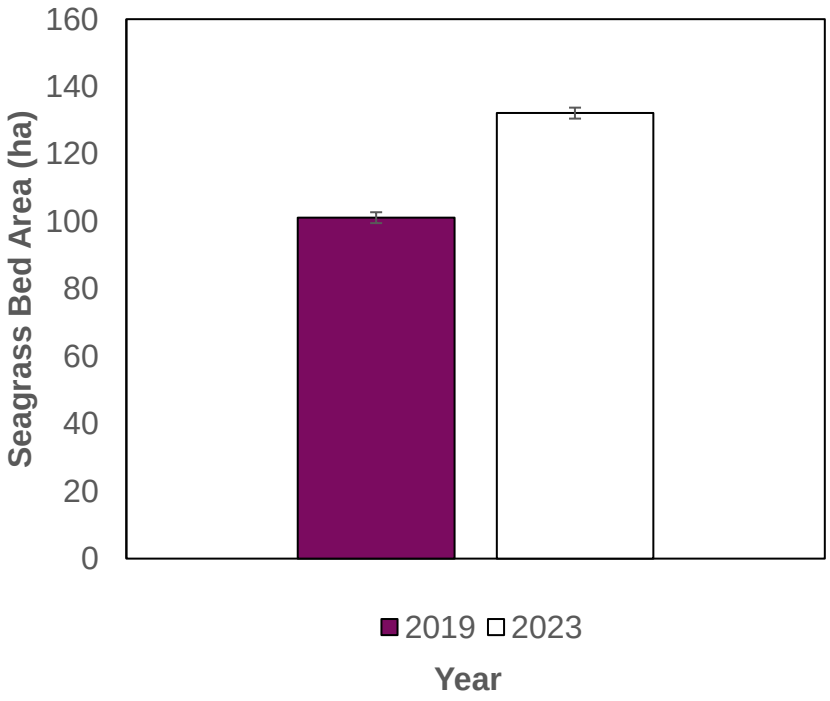

Figure 3. Total seagrass bed area for 2019 and 2023, error bars show standard error

The dataset is not of sufficient size to carry out individual t-tests for each survey location, however the seagrass beds have been grouped by survey location and compared on a bar graph with standard error bars, in Figures 4 and 5.

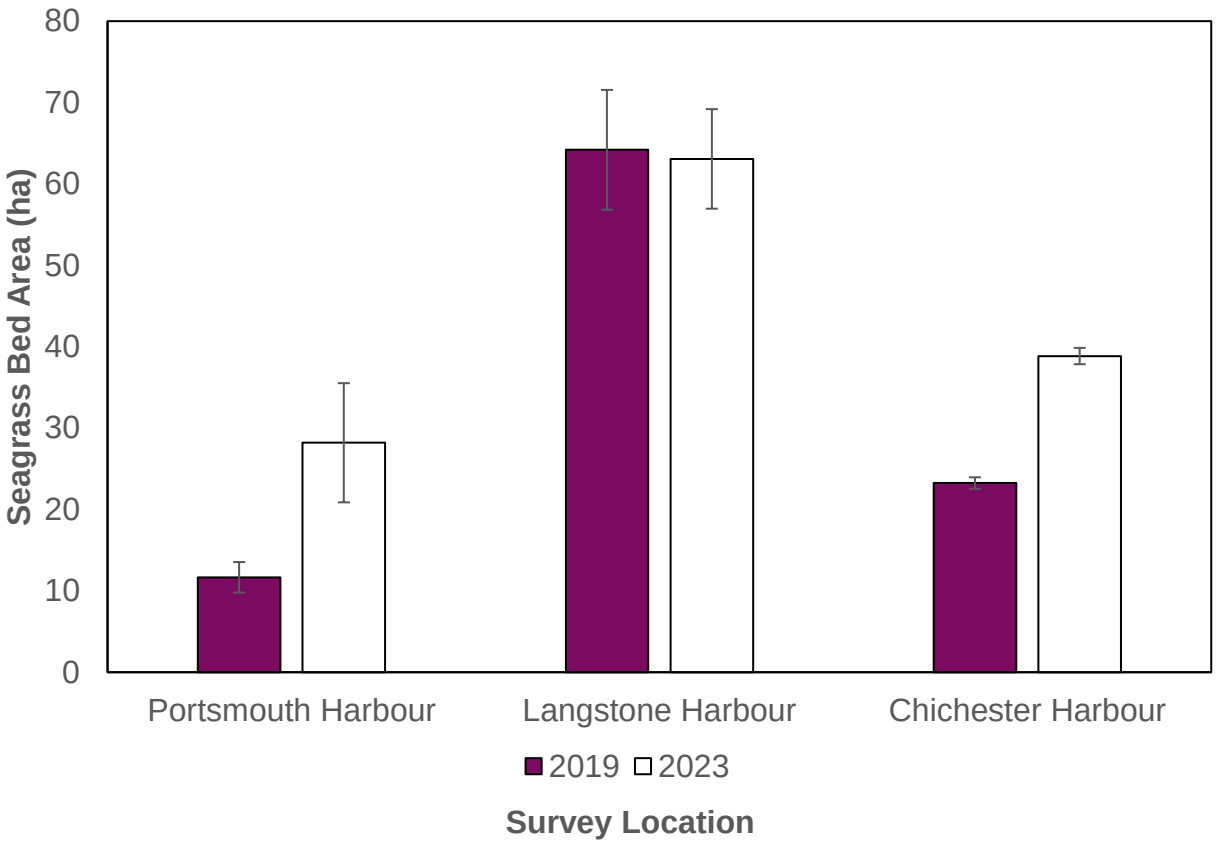

Figure 4. Seagrass bed area for mainland survey locations for 2019 and 2023, error bars show standard error

A significant increase in seagrass bed area was recorded at Portsmouth Harbour and Chichester Harbour, whilst no significant change was recorded at Langstone Harbour.

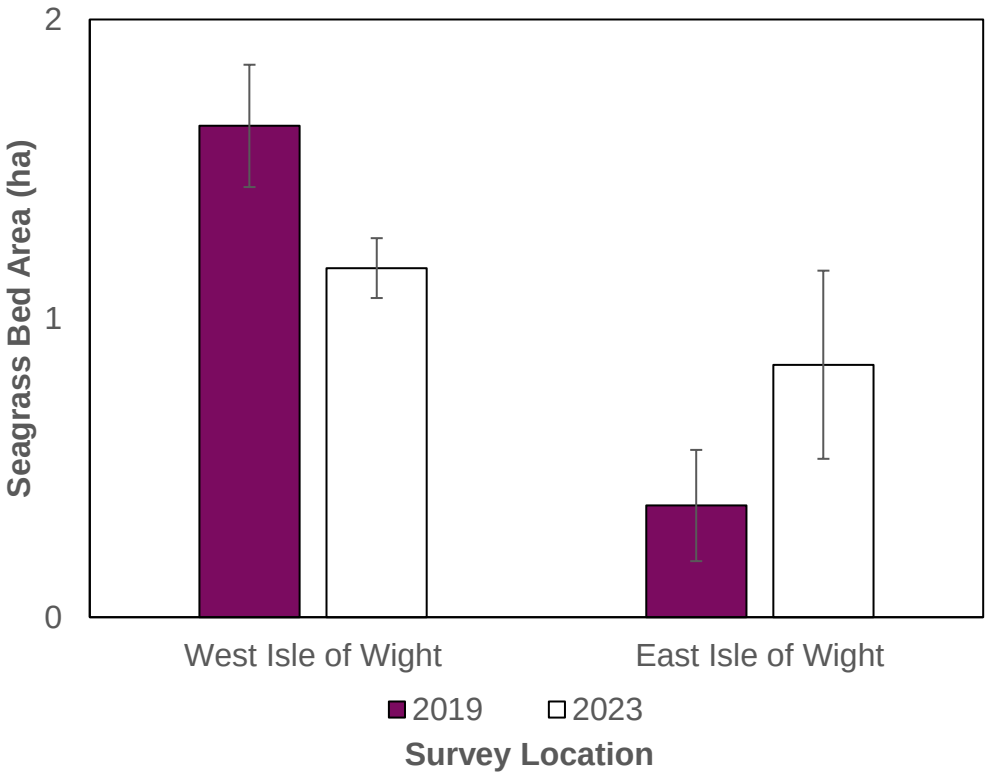

Figure 5. Seagrass bed area for Isle of Wight survey location for 2019 and 2023, error bars show standard error

A significant decrease in seagrass bed area was recorded at the West Isle of Wight sites, whilst no significant change was recorded at the East Isle of Wight sites.

Recommendations

It is recommended that areas which were not accessible in 2023 (i.e. East Gosport, Medina, Needs Ore, Oar Rithe and Yarmouth,) are re-surveyed in the future using an alternative survey method such as surveying by drone, boat, scuba diving and/or waterproof handheld camera to provide an up-to-date assessment of the extent and condition of seagrass at these locations.

A number of other areas were identified during the 2023 surveys where it appeared that seagrass extent had increased beyond the survey areas, but it was not possible to survey their entirety due to time constraints, incoming tides and difficulties with access such as the presence of large impassable channels. Some beds also extend out into the shallow subtidal areas which were outside the scope of these surveys which focussed on intertidal beds. In addition, data from drone surveys undertaken by the University of Portsmouth should be obtained and collated with that gathered from these surveys to assess the full extent of seagrass at Farlington.

Chichester Harbour Conservancy will also be conducting seagrass surveys in the harbour in 2024. This will extend these surveys carried out within Chichester Harbour in 2023 and include the mapping of additional areas that surveyors were unable to reach due to time, tide and access constraints.

Conclusion

Seagrass was found in all areas surveyed where the beds were accessible. This included a mix of *Z. noltii*, *Z. marina* and *Z. marina* ecotype. A total seagrass bed coverage of 251.18ha was recorded across the areas surveyed within the Solent and Isle of Wight. Beds consisting of a mix of *Z. noltii* and *Z. marina* ecotype made up approximately 40% of this total area, covering 101.04ha, closely followed by mixed beds of *Z. noltii* and *Z. marina* which covered a total area of 88.05ha (35% of all seagrass beds recorded). The majority of the beds were mixed with much smaller areas consisting of just a single species of seagrass.

Coverage of seagrass across the survey areas was largely similar to previous year's survey data, however, there were notable expansions as well as some contractions of beds. However, it is not currently known the exact causes of this, and these may be due to a combination of reasons such as anthropogenic pressures and/or pollution or other factors such as climate change. In addition, new areas were observed and mapped which had not been included in the seagrass inventory previously. This included a new seagrass bed at Fareham Lake off the coast of Porchester, and new beds within Mill Rythe and the Kench around Hayling Island.

Seagrass was recorded across 18 designated sites within the Solent and Isle of Wight including SSSIs, SPAs, SACS, Ramsars and MCZ. Analysis was undertaken to determine the total hectares of seagrass recorded within each MPA. The majority was found within SSSIs and Ramsar sites with a total of 228.48ha of seagrass in these areas while MCZs had the smallest seagrass beds within the survey areas with a total of 23.02ha observed.

The average seagrass bed size significantly increased between 2019 and 2023 ($t=-3.398$, $p<0.05$) from 3.89ha to 5.08ha. The total area of comparable seagrass beds was 101.12ha in 2019 compared to 132.13ha in 2023. This is an increase of 31% of bed size within the areas re-surveyed. It should be noted that large areas of "mosaic" beds, comprising many smaller patches, were mapped as single beds with the extent drawn around the entire group of patches. Therefore, some areas included within the calculations would include sediment patches rather than a complete seagrass bed and consequently produce a slight overestimate of seagrass bed size. Caution should be exercised when interpreting the results of this data.

No invasive non-native species or pathogens found in any seagrass beds on any of the surveys. However, there is an abundance of algae at some of the locations and notable signs of anthropogenic pressures were observed such as gauges/dredge marks, significant pollution and discolouration of mud, all of which are likely to negatively impact seagrass. Continued monitoring of these beds and additional surveys of other areas across the Solent should be carried out, to ensure that these seagrass beds maintain and increase their extent.

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Marsden, A. L., and Chesworth, J. C. 2015. Inventory of eelgrass beds in Hampshire and the Isle of Wight 2015, Section One: Report. Version 7: May 2015.: Hampshire and the Isle of Wight Wildlife Trust, Curdridge.

Photographs

Photograph 1. Example of patches of *Zostera marina* on a sand substrate

Photograph 2. Example of a quadrat showing dense algae with seagrass beneath

Photograph 3. Example of a quadrat showing a mix of *Zostera noltii* and dense algae

Photograph 4. Example of anthropogenic pressures where boats have been dragged across the mud

Photograph 5. Dense *Zostera marina* bed with up to 100% coverage

Photograph 6. Example of seagrass extending out into a channel

Photograph 7. Example of seagrass extending out into a channel

Photograph 8. Example of anthropogenic pressures where boats have been dragged across the mud

Photograph 9. Example of seagrass mixed with seaweed

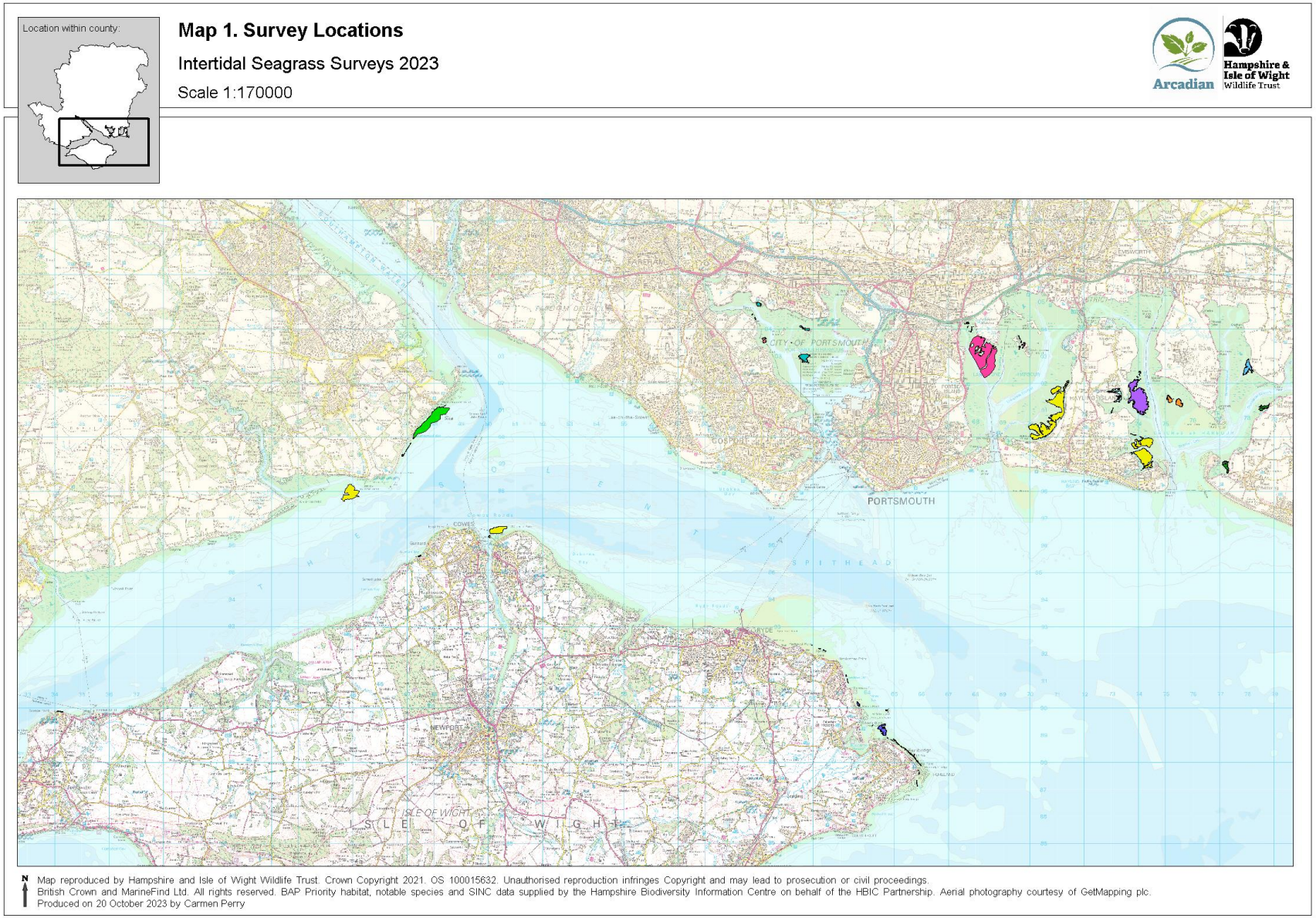
Photograph 10. Example of discoloured mud, likely due to a pollution event

Photograph 11. Example of discoloured mud, likely due to a pollution event

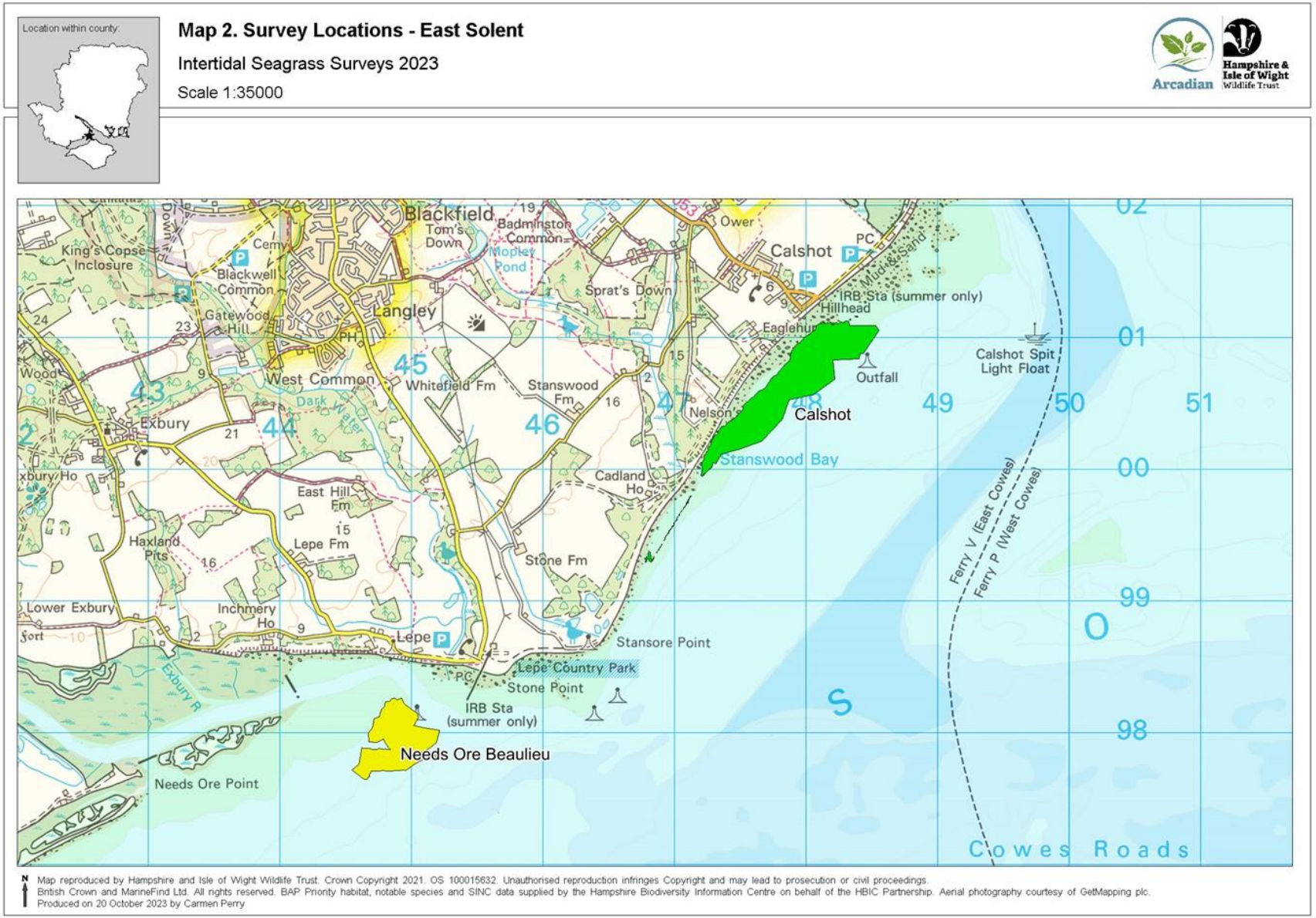
Photograph 12. Example of an individual *Zostera marina* plant

Maps

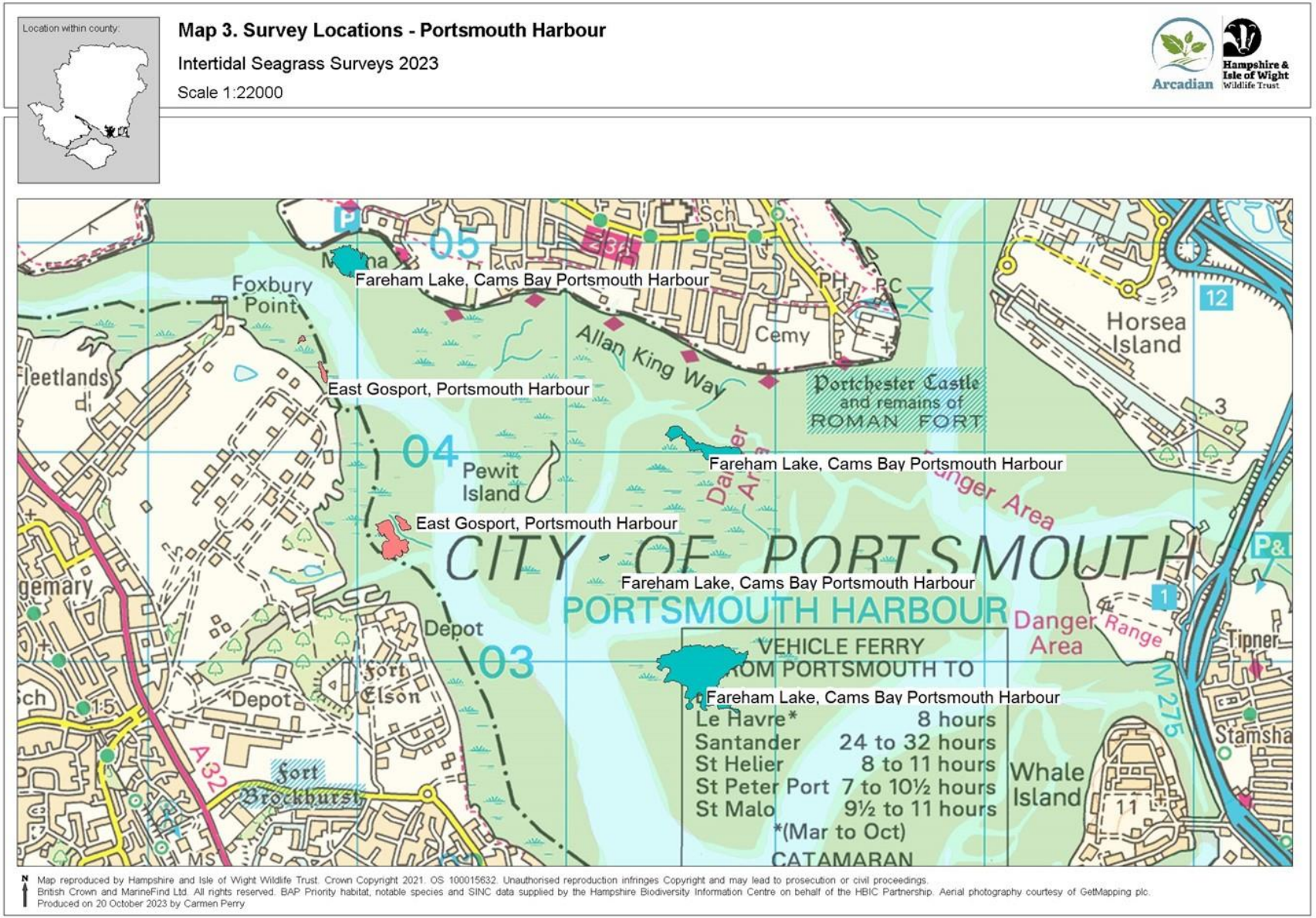
Map 1. Survey Locations



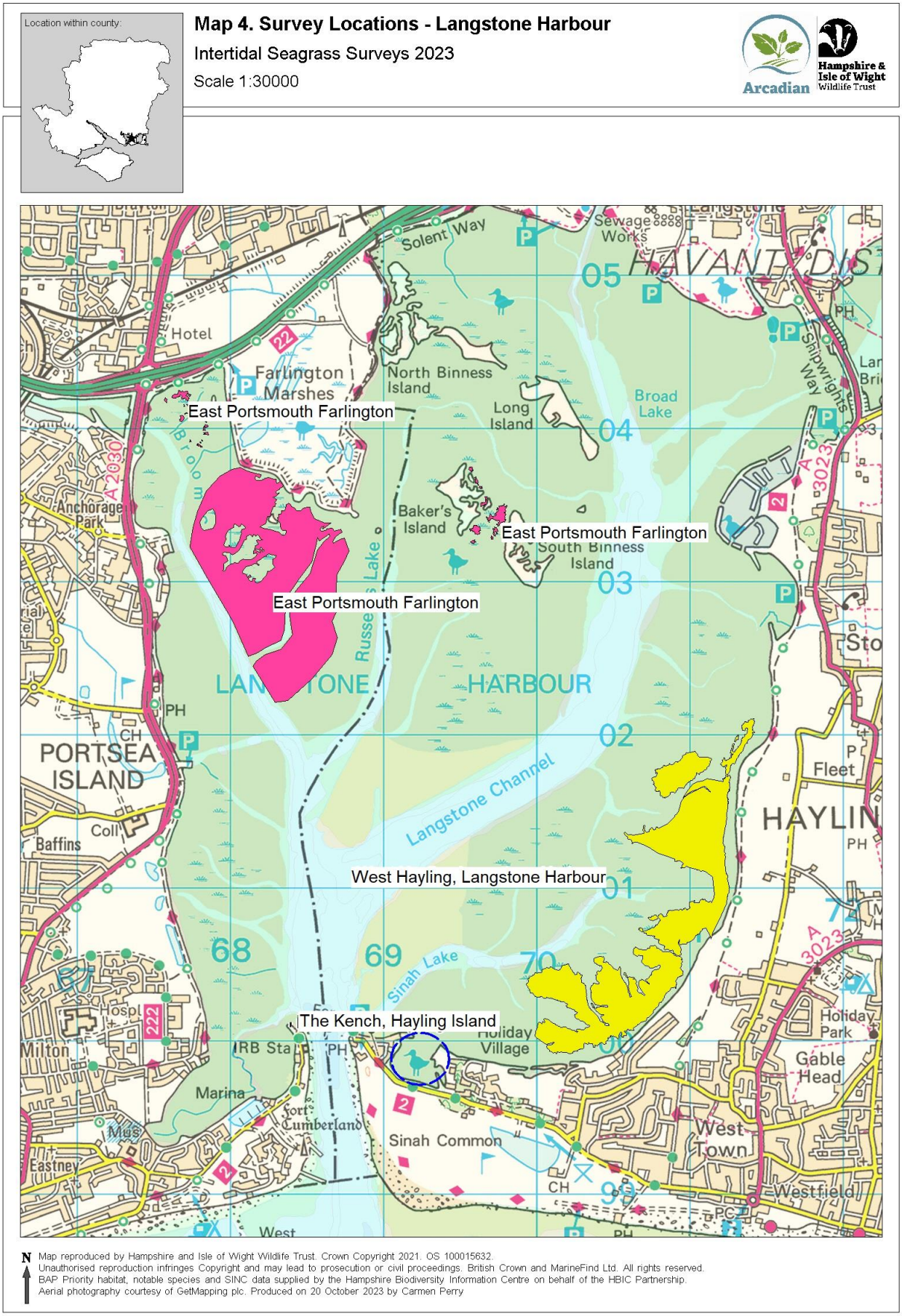
Map 2. Survey Locations – East Solent



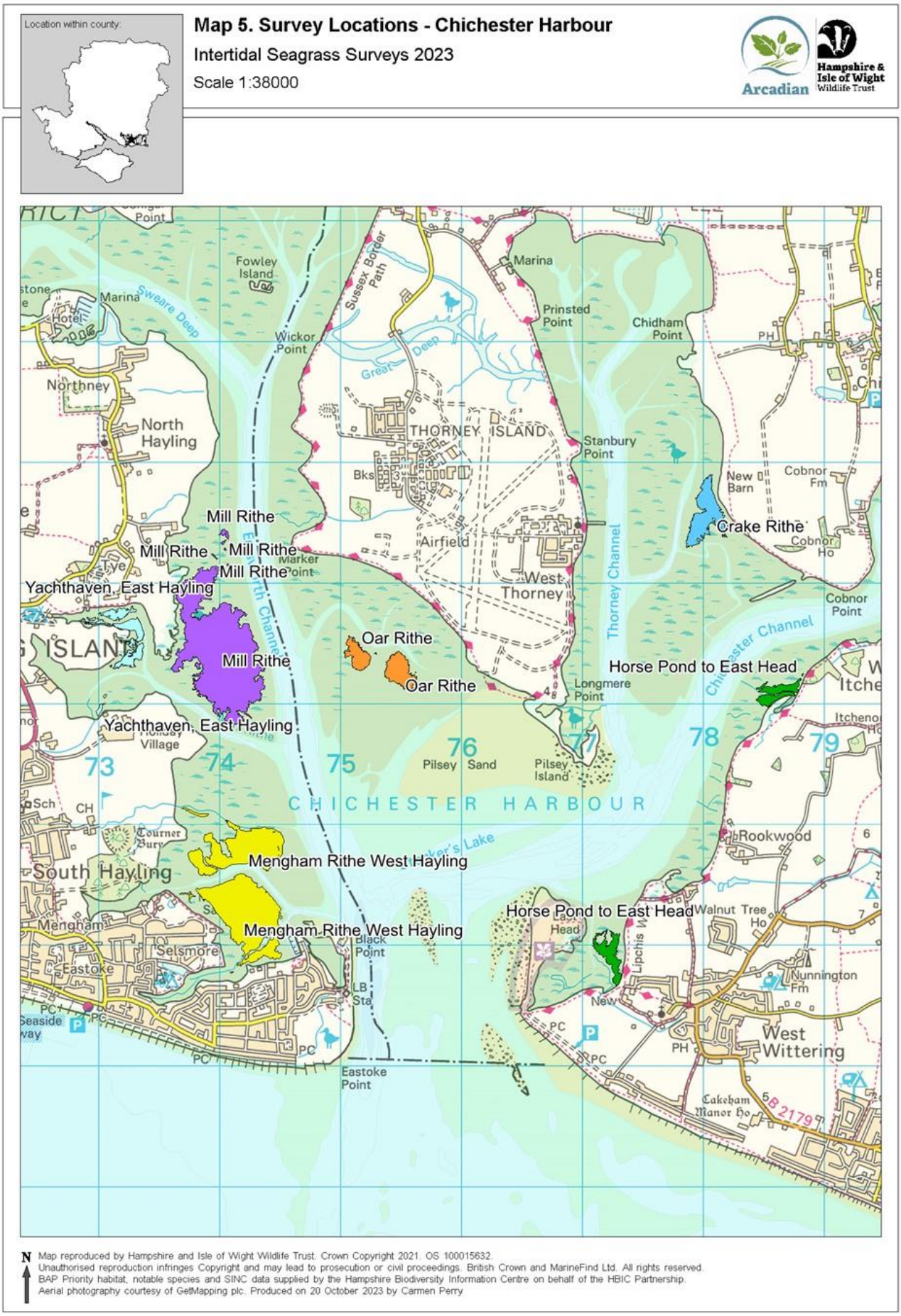
Map 3. Survey Locations – Portsmouth Harbour



Map 4. Survey Locations – Langstone Harbour



Map 5. Survey Locations – Chichester Harbour



Map 6. Survey Locations – West Isle of Wight

Map 7. Survey Locations – East Isle of Wight

Appendices

Appendix 1. Raw attribute data taken from quadrats points at each site

Calshot, East Solent

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zm	60	Sand	None	None	None
2	3.9	Zm	95	Sand	None	None	None
3	3.9	Zm	30	Sand	None	None	None
4	3.6	Zm	75	Sand	None	None	None
5	3.9	Zm and Zn	50	Sand	None	Present	None
6	4.1	Zn	25	Sand	None	Present	None

Fareham Lake, Cams Bay, Portsmouth Harbour

Known beds

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zm	60	Mud	None	Present	None
2	3.9	Zn	60	Mud	None	Present	Pollution
3	3.9	Zn and Zm	30	Mud and gravel	None	Present	None
4	3.9	Zn and Zm	70	Mud and gravel	None	Present	None
5	3.9	Zm	30	Mud	None	Present	None
6	3.9	Zn	40	Mud	None	Present	Gauges in mud
7	4.5	Zn	80	Mud	None	None	None
8	3.5	Zn	40	Mud	None	Present	None

New area

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	4.0	Zn	75	Mud	None	None	None
2	4.4	Zn	95	Mud	None	Present	None
3	3.9	Zn	20	Mud	None	Present	None
4	2.6	Zn	30	Mud	None	Present	None
5	10.4	Zm	10	Mud	None	Present	None
6	3.9	Zn	100	Mud	None	Present	None
7	3.9	Zn and	70	Mud	None	Present	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
		Zm e					
8	8.5	Zn and Zm e	50	Mud	None	None	Marine litter
9	3.9	Zm e	25	Mud and gravel	None	None	None
10	3.9	Zm e	50	Mud	None	None	None
11	3.9	Zn	15	Mud	None	None	None
12	3.9	Zn	30	Mud and gravel	None	None	None
13	3.9	Zm e	25	Mud	None	None	None
14	3.9	Zn	80	Mud	None	None	Marine litter
15	3.9	Zn	90	Mud	None	Present	None

Farlington, Portsmouth Harbour

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	8	Zn	30	Mud	None	Present	None
2	3.8	Zn	30	Mud	None	Abundant	None
3	4	Zm	25	Mud	None	Present	None
4	3.9	Zn and Zm	25	Mud	None	Present	None
5	3.8	Zm	20	Mud	None	Abundant	None
6	3.6	Zm	40	Mud	None	Present	None
7	4.2	Zm	20	Mud and gravel	None	None	None
8	9	Zm	10	Mud and gravel	None	None	None
9	4.1	Zn and Zm	30	Mud	None	Present	None
10	4.5	Zm	25	Mud	None	None	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
11	4	Zm	40	Mud	None	Present	None
12	4	Zn	30	Mud	None	None	None
13	4.1	Zn and Zm	15	Mud	None	None	None
14	4.1	Zn and Zm	25	Mud	None	Present	None
15	3.8	Zn	20	Mud	None	Present	None
16	3.9	Zn	40	Mud	None	Present	None
17	3.9	Zn and Zm e	80	Mud	None	Present	None
18	3.9	Zm e	70	Mud	None	Present	None
19	3.9	Zm e	90	Mud	None	Present	None
20	3.6	Zm e	20	Mud	None	Abundant	None
21	3.9	Zm e	70	Mud	None	Present	None
22	3.9	Zn and Zm e	30	Mud	None	Abundant	None
23	3.9	Zn and Zm e	50	Mud	None	Abundant	None
24	4	Zn and Zm e	30	Mud	None	Present	None
25	3.9	Zn	80	Mud	None	Present	None
26	3.9	Zn and Zm e	70	Mud	None	Present	None
27	3.9	Zm e	70	Mud	None	Abundant	None
28	3.9	Zn	40	Mud	None	Present	None
29	3.9	Zn and Zm e	75	Mud	None	None	None
30	3.9	Zn	60	Mud	None	Present	None
31	3.9	Zm	15	Mud	None	Present	None
32	3.9	Zm e	90	Mud	None	Present	None
33	3.9	Zn and Zm e	75	Mud	None	Present	None
34	3.9	Zn	75	Mud	None	Present	None
35	3.9	Zm e	80	Mud	None	Present	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
36	3.9	Zm e	100	Mud	None	None	None

The Kench, West Hayling

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zn	50	Mud	None	None	None
2	3.9	Zn	10	Mud	None	None	None
3	3.9	Zn	1	Mud	None	None	None
4	9.1	Zm	10	Mud	None	None	None
5	7	Zn	70	Mud	None	None	None
6	4	Zn	75	Mud	None	Present	None
7	4	Zn	60	Mud	None	Present	None
8	5.2	Zn	40	Mud	None	None	None

West Hayling, Langstone Harbour

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.4	Zn	30	Mud	None	None	None
2	3.6	Zn	40	Mud	None	None	None
3	3.7	Zn	30	Mud	None	None	None
4	3.9	Zn	30	Mud	None	Present	None
5	4	Zn	20	Mud	None	Present	None
6	4	Zn	10	Mud	None	Present	None
7	3.8	Zn	25	Mud	None	Present	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
8	4.8	Zn	20	Mud	None	Present	None
9	3.7	Zn	25	Mud	None	Present	None
10	4.2	Zn	70	Mud	None	Abundant	None
11	3.9	Zn	90	Mud	None	Present	None
12	4.3	Zn	Unknown	Mud	None	Abundant	None
13	3.9	Zn	5	Mud	None	Present	None
14	3.5	Zn	30	Mud	None	Present	None
15	3.2	Zn	10	Mud	None	Present	None
16	3.6	Zn	80	Mud	None	Present	None
17	4.5	Zn	80	Mud	None	Present	None
18	3.9	Zn	20	Mud	None	Present	None
19	4	Zn	20	Mud	None	Silty	None
20	3.9	Zn	20	Mud	None	Algae and silt	None
21	4	Zn	25	Mud	None	None	None
22	3.9	Zn	40	Mud	None	None	None
23	5.5	Zn	80	Mud	None	None	None
24	3.9	Zn	25	Mud	None	None	None
25	4.3	Zn	30	Mud	None	None	None
26	3.9	Zn	80	Mud	None	Present	None
27	3.9	Zn	70	Mud	None	Present	None
28	3.9	Zn	40	Mud	None	Abundant	None
29	3.9	Zn	50	Mud	None	Abundant	None
30	3.5	Zn	95	Mud	None	Present	None
31	3.7	Zn	90	Mud	None	Present	None
32	3.9	Zm	90	Mud	None	Present	None
33	3.9	Zn	80	Mud	None	Silty	None
34	3.9	Zn	80	Mud	None	Abundant	None
35	3.9	Zn	90	Mud	None	Present	None
36	3.9	Zn	30	Mud	None	Abundant	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
37	3.9	Zn	70	Mud	None	Abundant	None
38	3.9	Zn	40	Mud	None	Abundant	None
39	3.9	Zn	80	Mud	None	Present	None
40	3.9	Zm	30	Mud	None	Present	None

Mengham Rithe, East Hayling

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	4.6	Zn	15	Mud	None	None	None
2	4.7	Zn and Zm	50	Mud	None	Present	None
3	8	Zn	70	Mud	None	Present	None
4	3.9	Zn	80	Mud	None	Present	None
5	3.9	Zn	10	Mud	None	None	None
6	3.9	Zn	25	Mud	None	Present	None
7	7.0	Zn	70	Mud	None	Present	None
8	7.0	Zn	95	Mud	None	None	None
9	8.0	Zn	80	Mud	None	Present	None
10	3.4	Zn	40	Mud	None	Present	None
11	9.0	Zn	80	Mud	None	None	None
12	3.9	Zn	95	Mud	None	None	None
13	4.0	Zn	95	Mud	None	None	None
14	3.9	Zn	90	Mud	None	None	None
15	3.9	Zn	30	Mud	None	Present	None
16	3.9	Zn and Zm	95	Mud	None	Present	None
17	4.0	Zn	95	Mud	None	None	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
18	7.0	Zn and Zm	90	Mud	None	None	None
19	4.0	Zn	40	Mud	None	Abundant	None
20	4.0	Zn	60	Mud	None	None	None
21	8.0	Zn	30	Mud	None	None	None
22	4.0	Zn	50	Mud	None	None	None
23	3.9	Zn	75	Mud	None	None	None
24	3.9	Zn	75	Mud	None	Present	None
25	6.0	Zn	70	Mud	None	Present	None
26	8.0	Zn	75	Mud	None	None	None
27	5.5	Zm e	95	Mud	None	None	None
28	3.9	Zm e	90	Mud	None	None	None
29	7.3	Zn	100	Mud	None	Present	Gauges/dredge marks in mud, likely from boat damage
30	3.9	Zn and Zm e	70	Mud	None	Present	None
31	8.2	Zn	50	Mud	None	Present	Gauges/dredge marks in mud, likely from boat damage
32	14.6	Zn	50	Mud	None	Present	None
33	3.9	Zn and Zm e	90	Mud	None	Present	None
34	2.6	Zn	60	Mud	None	Present	None
35	3.4	Zm e	100	Mud	None	Present	None
36	3.9	Zn	65	Mud	None	Present	None
37	3.9	Zn	60	Mud	None	None	None
38	3.9	Zm	95	Mud	None	Present	None
39	3.9	Zn	80	Mud	None	Abundant	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
40	3.9	Zn	60	Mud	None	None	None
41	3.9	Zn	80	Mud	None	Present	None

Mill Rithe, East Hayling

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zn	50	Mud	None	None	None
2	3.9	Zn and Zm e	40	Mud	None	Present	None
3	10	Zn	80	Mud	None	None	None
4	3.9	Zn	100	Mud	None	None	None
5	8.2	Zn	50	Mud	None	None	None
6	6.1	Zm e	90	Mud	None	None	None
7	10.4	Zn and Zm e	75	Mud	None	Present	None
8	5.5	Zn and Zm	70	Mud	None	Present	None
9	7.3	Zn	90	Mud	None	Present	None
10	3.9	Zn	70	Mud	None	None	None
11	3.9	Zn and Zm e	80	Mud	None	None	None
12	4	Zn and Zm e	90	Mud	None	None	None
13	2.9	Zn	95	Mud	None	None	None
14	3.5	Zn	40	Mud	None	None	None
15	3.9	Zn and Zm	80	Mud	None	None	None
16	3.7	Zn	20	Mud	None	None	None
17	3.1	Zn	50	Mud	None	None	None

Yachthaven, East Hayling

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.3	Zm	60	Mud	None	Present	Signs of pollution
2	3.8	Zn	75	Mud	None	Present	None
3	3.9	Zm	80	Mud	None	Present	None
4	3.4	Zm	80	Mud	None	Present	None
5	3.8	Zm and Zn	75	Mud	None	None	None
6	3.9	Zn	70	Mud	None	Present	None
7	3.9	Zn	40	Mud	None	Abundant	None
8	3.4	Zn	50	Mud	None	Present	None
9	3.7	Zn	40	Mud	None	Abundant	None
10	3.5	Zm and Zn	80	Mud	None	Present	None
11	3.1	Zn	90	Mud	None	Present	None
12	3.6	Zm	70	Mud	None	Present	None
13	3.7	N/a	N/a	Mud	None	Present	Gauges in mud caused by boat damage
14	3.3	Zn	100	Mud	None	Present	None
15	3.3	Zn and Zm e	80	Mud	None	Abundant	None
16	4.8	Zn	85	Mud	None	Present	None
17	5.2	Zn and Zm e	95	Mud	None	Present	None
18	3.5	Zm	50	Mud	None	Present	None
19	3.9	Zn	30	Mud	None	Present	None
20	3.9	Zn	15	Mud	None	Present	None
21	3.8	Zn	30	Mud	None	Present	None
22	3.9	Zn	25	Mud	None	Present	None
23	3.5	Zm	15	Mud	None	None	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
24	3.5	Zm	70	Mud	None	None	None
25	3.8	Zm	10	Mud	None	None	None
26	4.8	Zm	20	Mud	None	None	None
27	3.8	Zm	75	Mud	None	None	None
28	4.7	Zm	25	Mud	None	None	None
29	3.9	Zm	60	Mud	None	None	None
30	3.9	Zm	70	Mud	None	Present	None
31	3.9	Zm and Zn	40	Mud	None	Present	None
32	3.9	Zn	15	Mud	None	Present	None
33	3.5	Zn	95	Mud	None	Present	None
34	3.9	Zn	5	Mud	None	Present	None
35	3.5	Zn	10	Mud	None	None	None
36	3.8	Zn	15	Mud	None	None	None
37	5.0	Zn	25	Mud	None	Present	None
38	2.7	Zn	60	Mud	None	Abundant	None
39	6.4	Zn	75	Mud	None	Present	None
40	3.9	Zn	80	Mud	None	Present	None
41	3.9	Zn	90	Mud	None	Present	None
42	3.9	Zn and Zm e	100	Mud	None	None	None
43	3.9	Zm e	95	Mud	None	Present	None

Crake Rithe, Chichester Harbour

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.8	Zm e	100	Mud and gravel	None	None	None
2	3.9	Zn	20	Mud	None	Present	None
3	3.9	Zn	20	Mud	None	Present	None
4	3.8	Zn	80	Mud	None	None	None
5	3.9	Zm e	15	Mud	None	None	None
6	3.9	Zm e	40	Mud	None	None	None
7	3.9	Zn	90	Mud	None	Present	None
8	3.9	Zm e	15	Mud and gravel	None	None	None
9	3.9	Zn	80	Mud	None	Present	None
10	3.8	Zn	70	Mud	None	Present	None
11	3.9	Zn	40	Mud	None	Present	None
12	3.9	Zn	30	Mud	None	Present	None
13	3.9	Zm e	85	Mud	None	Present	None
14	3.9	Zm e	90	Mud	None	Present	None
15	3.9	Zn	20	Mud	None	Present	None
16	3.9	Zn	20	Mud	None	Present	None
17	3.9	Zn	10	Mud	None	None	None
18	3.9	Zn	5	Mud	None	None	None
19	3.9	Zm e	50	Mud	None	Present	None
20	3.9	Zn	70	Mud	None	Present	None
21	3.9	Zn	5	Mud	None	Present	Discoloured mud
22	3.9	Zn	25	Mud	None	Present	Discoloured mud
23	3.9	Zn	30	Mud	None	Present	None
24	3.9	Zm e	80	Mud	None	Present	None
25	3.9	Zn	25	Mud	None	Present	None
26	3.9	Zn and	30	Mud	None	Present	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
		Zm e					
27	3.9	Zn and Zm e	90	Mud	None	Present	None
28	3.9	Zm e	85	Mud	None	Present	None
29	3.9	Zm	70	Mud	None	Present	None
30	4.0	Zm e	60	Mud	None	Present	None
31	4.0	Zn	80	Mud	None	Present	None

Horse Pond to East Head, Chichester Harbour

Itchenor

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zn	90	Mud	None	Present	None
2	3.9	Zn	60	Mud	None	None	None
3	3.9	Zn	25	Mud	None	None	Gauges/dredge marks in mud
4	3.9	Zn	30	Mud	None	Present	None
5	3.9	Zn	80	Mud	None	Present	None
6	3.9	Zn	90	Mud and cockles	None	Present	None
7	4.0	Zn	80	Mud	None	Present	None
8	3.6	Zn	50	Mud	None	Present	None
9	3.5	Zn	10	Mud	None	Present	Discoloured mud
10	3.7	Zn	15	Mud	None	None	None
11	3.6	Zn	25	Mud	None	Present	None
12	3.9	Zn and Zm e	60	Mud	None	Present	None
13	3.9	Zn	90	Mud	None	Present	None
14	3.9	Zn	60	Mud	None	Present	None
15	3.7	Zn	40	Mud	None	Present	Some dead seagrass plants
16	4.6	Zn and Zm e	80	Mud	None	Present	None
17	3.4	Zn	50	Mud	None	Present	None
18	3.7	Zn	95	Mud	None	Present	None

East Head, West Wittering

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	6.0	Zn	10	Mud	None	None	None
2	4.5	Zn	60	Mud	None	Present	None
3	3.9	Zn	30	Mud	None	Present	None
4	3.9	Zn	50	Mud	None	Present	None
5	4.2	Zn	70	Mud	None	Present	None
6	7.0	Zn	80	Mud	None	Present	None
7	3.6	Zn	90	Mud	None	Present	None
8	3.6	Zn	85	Mud	None	Present	None
9	3.6	Zn and Zm	90	Mud	None	Present	Pollution
10	3.8	Zn	80	Mud	None	Present	None
11	3.9	Zm	70	Mud	None	Present	None
12	3.9	Zn and Zm	65	Mud	None	None	None

Gurnard, Isle of Wight

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zm	40	Sand	None	None	None
2	3.9	Zm	10	Sand	None	None	None
3	3.5	Zm	5	Sand	None	None	None
4	3.9	Zm	2	Sand	None	None	None
5	3.7	Zm	1	Sand	None	None	None

Seagrove to Priory Bay and Bembridge, Isle of Wight

Seagrove

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zm	10	Sand	None	None	None
2	3.4	Zn	10	Sand	None	None	None

Priory Bay

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.6	Zm	60	Sand	None	Present	None
2	3.6	Zm	30	Sand	None	Present	None
3	6.0	Zm	30	Sand	None	None	None
4	3.9	Zm	70	Sand	None	Present	None
5	3.6	Zm	95	Sand	None	None	None
6	4.0	Zm	25	Sand	None	None	None
7	3.9	Zm	60	Sand	None	Present	None
8	3.9	Zm	20	Sand	None	Present	None
9	3.6	Zm	75	Sand	None	None	None
10	6.0	Zm	10	Sand	None	Present	None
11	3.9	Zm	25	Sand	None	None	None
12	3.9	Zm	10	Sand	None	None	None
13	3.8	Zm	50	Sand	None	Present	None
14	4.8	Zm	80	Sand	None	None	None
15	3.5	Zm	10	Sand	None	None	None
16	3.9	Zm	30	Sand	None	None	None
17	3.9	Zm	40	Sand	None	Present	None

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
18	3.8	Zm	60	Sand	None	Present	None
19	3.5	Zn and Zm	90	Sand	None	Present	None
20	3.9	Zn	70	Sand	None	Present	None
21	3.7	Zn and Zm	80	Sand	None	None	None
22	7.0	Zn	70	Sand	None	Present	None
23	3.9	Zm	5	Sand	None	Present	None
24	3.9	Zn	50	Sand	None	Present	None
25	3.9	Zn	10	Sand	None	Present	None
26	4.1	Zm	10	Sand	None	None	None
27	4.2	Zm	15	Sand	None	Present	None
28	4.1	Zm	50	Sand	None	Present	None
29	3.9	Zm	100	Sand	None	Present	None
30	3.9	Zm	70	Sand	None	Present	None
31	3.9	Zm	60	Sand	None	Present	None
32	4.1	Zm	10	Sand	None	None	None

Bembridge Bay

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	3.9	Zm	30	Sand	None	Present	None
2	3.9	Zm	100	Sand	None	Present	None
3	3.9	Zm	80	Sand	None	Present	None
4	3.6	Zm	95	Sand	None	Present	None
5	3.9	Zm	75	Sand	None	Present	None
6	3.4	Zm	40	Sand	None	Present	None

Bembridge Point

Sampling point	Seagrass attributes						
	Precision (m)	Species	Density (% cover)	Substrate	Non-native species and pathogens	Water quality (algae)	Anthropogenic pressures
1	4.5	Zm	85	Sand	None	Present	None
2	3.5	Zm	50	Sand	None	Present	None
3	3.6	Zm	95	Sand	None	None	None
4	3.9	Zm	100	Sand	None	None	None
5	4.0	Zm	0	Sand	None	None	Dead seagrass
6	3.9	Zm	100	Sand	None	Present	None
7	3.9	Zm	40	Sand	None	None	None

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