Monitoring Plan

SBMP Research and Monitoring Group, December 2023

Spiny seahorses at Studland Bay, The Seahorse Trust

EXECUTIVE SUMMARY

This document presents the monitoring plan that supports the Studland Bay Marine Partnership's seagrass restoration strategy. The plan itself is presented in section 4. The primary aim of the plan is to monitor the impact of the installation of 100 eco-moorings on the seagrass beds within the Studland Bay Marine Conservation Zone, and upon the biodiversity and ecosystem services that the beds support.

1. INTRODUCTION AND BACKGROUND

1.1 WHY SEAGRASS MATTERS

The shallow, sheltered waters of Studland Bay provide the perfect conditions for one of the most valuable habitats in our seas. Beneath the waves lies an extensive seagrass meadow that is home to an incredible diversity of marine wildlife, including the spiny seahorse, pipefishes and wrasses. It also provides a nursery for endangered species such as the undulate ray, and commercial species like bream and flatfish. As well as boosting biodiversity seagrass provides numerous ecosystem services: Seagrass beds hold significant quantities of carbon that would otherwise be in the atmosphere, helping us to mitigate the impacts of climate change. They also play an important role in reducing coastal erosion, stabilising the seabed, improving water quality and buffering ocean acidification. The only flowering plant to colonise the seabed, these unique and vibrant habitats also create real opportunities to inspire people to connect with and protect our marine environment.

1.2 WHY IS SEAGRASS UNDER THREAT?

Seagrass beds across the UK have declined significantly over the last century. Recent research estimates UK seagrass habitat losses of at least 44% since 1936, with 39% of those losses occurring since the 1980s and some values reaching as high as 92% (Green et al. 2021). This extensive loss is the result of a complex combination of factors, many of which can be directly attributed to human disturbance such as eutrophication, coastal development, fisheries and boat activity (Collins *et al.,* 2010). Extensive outbreaks of a wasting disease, *Labyrinthula zosterae*, has been described as another cause of loss in the 1930s, but this itself is likely the result of environmental degradation (Gamble *et al.*, 2021). The common eelgrass (*Zostera marina*) beds of Studland Bay are currently in unfavourable condition. The sheltered conditions that allow the seagrass to thrive also mean that the area is highly valued by boat users as a sheltered refuge and popular anchorage. Anchors and traditional moorings damage the seagrass meadows and fragment the habitat.

1.3 RESTORING STUDLAND'S SEAGRASS

Ecomooring, boatfolk

Since 2019 Studland Bay has been protected as a Marine Conservation Zone (MCZ). A phased Voluntary No-Anchor Zone (VNAZ) was then established in 2021. In the same year the Studland Bay Marine Partnership (SBMP) was formed with the aim of developing solutions to restore the seagrass beds whilst enabling recreational boating to continue. The SBMP is comprised of stakeholders from the boating community, conservation charities, researchers, community organisations, local authorities and statutory bodies. Through a culture of collaborative working the SBMP has made significant progress in bridging the once divisive gap between boating and conservation communities and has raised the profile of seagrass restoration through an extensive public engagement programme. The group have developed the Studland Bay Seagrass Restoration 10 Year Strategy. At the heart of this strategy is the installation of 100 publicly available Eco-moorings that allow boats to moor without the damage to the seagrass beds.

1.4 MONITORING STUDLAND BAY

An exciting area of progress within the SBMP in 2023 has been the establishment of the Research and Monitoring Group (RMG). The RMG consists of representatives from the following organisations: National Trust, The Seahorse Trust, University of Southampton, Swansea University, University of Plymouth, Bournemouth University, Environment Agency, Marine Management Organisation, Sea Life and Sea Life Trust.

The group was formed to share knowledge between partners working on different aspects of seagrass restoration, as well as to support the partnership with high quality, evidence-based information to help deliver the project and to monitor its progress. As a partnership we are very fortunate to be working with leading experts in marine conservation, with experience across numerous different fields including marine ecology, social science, oceanography, marine policy and coastal dynamics. Many of the members of the RMG have been involved directly in working in Studland Bay, bringing the benefits of a wealth of local experience to the team.

The RMG has four objectives:

Audit what research and monitoring has taken place in the bay and establish a baseline condition for the seagrass beds.

Develop a monitoring plan for the project that enables us to measure how well the installation of ecomoorings/Voluntary No Anchor Zone (VNAZ) is working.

Identify future research opportunities in the bay.

Support the Comms Group by developing accessible engagement materials; helping to bust the myths and knowledge gaps that have been identified during the extensive consultation work undertaken by the SBMP.

This document addresses the first two objectives by providing an overview of the academic and statutory monitoring that has already been carried out in the bay over recent decades. We then build upon this to develop a monitoring plan to support the SBMP's restoration strategy; specifically focusing on monitoring the impact of the eco-moorings within the VNAZ.

2. PAST AND CURRENT MONITORING IN STUDLAND BAY

2.1 MCZ FEATURES: INCLUDING SEAGRASS EXTENT, FUNCTION AND BIODIVERSITY

In July 2021 a new cycle of monitoring the extent and condition of the subtidal seagrass at Studland commenced. Studland was previously surveyed in 2018 by the Environment Agency to record the seagrass extent and percent cover (Green, 2018). Natural England led the 2021 survey programme reporting on the following attributes: extent and distribution; structure and function (including density, overall health and species composition of characteristic biological communities); data to support the assessment of the spiny seahorse population.

For the full report please see: Doggett and Northern (2023) Studland Bay Marine Conservation Zone (MCZ): Subtidal Seagrass Monitoring Survey 2021 - NECR449 (naturalengland.org.uk). The key findings from the 2021 surveys were as follows:

- With one exception the density and distribution of the seagrass at each monitoring station was broadly in line with the results of the 2018 survey. Where seagrass does occur, overall mean percentage cover values were in the range of 24-81%.
- Seagrass wasting disease, *Labyrinthula sp*. was observed across the sites monitored, with the highest infection scores found in the south.

- Non-native species were recorded throughout the bay, mostly in low abundance. The exception was the tetrasporophyte phase of harpoon weed, *Asparagopsis armata*, which occurred in high numbers in some areas.
- Anchor and mooring damage to the seagrass was apparent throughout the areas monitored, leaving bare sand patches, exposed rhizomes and detached plants. Not all bare sand patches could be attributed to anchor or mooring impacts although the cause of some damage observed was unequivocal.
- No seahorses were observed during the survey.

The 2021 survey was completed by using dive operations (quadrat and shoot sample analysis) in order to provide high quality data to allow key attributes of the seagrass feature to be assessed. The 2018 survey (utilising drop camera analysis) was repeated in 2022 and will be repeated in the future as part of the Environment Agency's routine monitoring. Extent and distribution were not monitored by the dive operations in 2021 but were monitored by the Environment Agency surveys undertaken in 2022. The results of the 2022 survey are still being analysed and are yet to be released. The latest extent and distribution data to be reported by the Environment Agency at the time of writing is therefore from the 2018 survey (Green, 2018) (figure 1). This 2018 survey calculated the seagrass area with >5% cover as 82.26 ha.

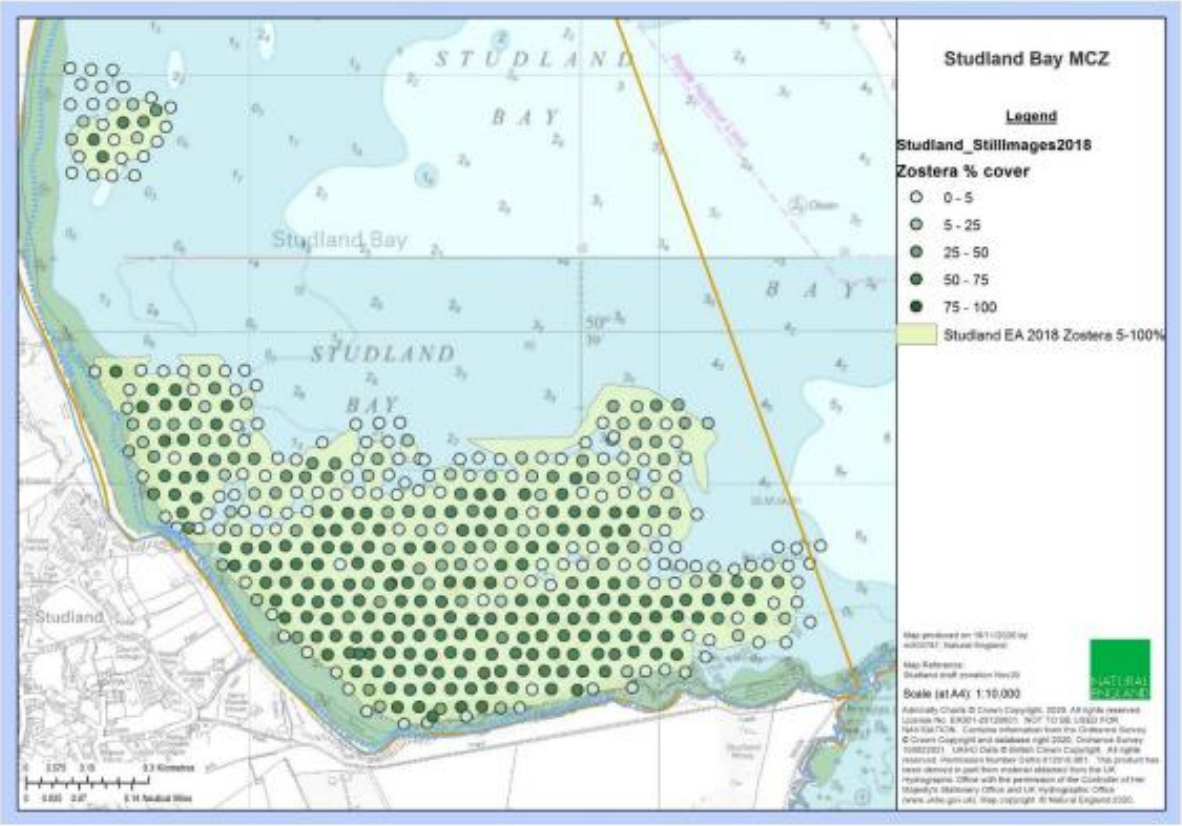


Figure 1: Seagrass extent mapped in 2018 by the Environment Agency (Green, 2018), reproduced by Natural England under the Open Government Licence. The area of seagrass beds (>5% cover) was calculated as 82.26 ha. The area of 1-5% cover was calculated as 19.14 ha.

Regular seahorse surveys are undertaken under licence by volunteers from the Seahorse Trust, who have reported the frequency and distribution of records within Studland Bay annually since 2008 (Garrick-Maidment, 2020). The Seahorse Trust considers the spiny seahorse population has declined over the last decade, although there was a significant increase in sightings recorded in 2020 during the start of the COVID-19 pandemic. Although the number of sightings increased significantly during this time, likely due to reduced human activity in the bay, the number of individuals only increased slightly. Whilst the different methods utilised and described by Garrick-Maidment (2020) have all been successful, Doggett and Northern (2023) recommended in their Natural England report that an assessment of the different efficacies of the survey methods would be beneficial. This could then be used to design an on-going monitoring programme using consistent methods with future sightings data adjusted per unit effort, in order to compensate for the differences in survey hours during different years. The Seahorse Trust are currently trialling using facial recognition to help identify individual seahorses.

Records of other fauna in the bay tend to be from 'one off' studies as opposed to a time series. A number of undergraduate dissertations from the University of Southampton have focused on the ecosystem within Studland Bay. Collins et al. (2010) compared the sediment infauna within seagrass to bare patches. In their study a total of 1473 organisms were identified, comprising of 54 families/species from eight taxonomic groups. The total fauna seagrass to scar ratio was 1134:339, indicating a much higher abundance found in the seagrass compared to the anchor and mooring scars. A higher diversity of taxa was also found in the seagrass compared to scar areas, with 50 and 38 species found respectively. Oligochaete tubificid worms were the most common individual fauna found in the samples. The diversity was highest among the polychaetes, with 18 families present in the samples. Overall, the infauna was dominated by polychaetes, oligochaetes, bivalves and amphipods. Doggett and Northern (2022) noted the presence of various species found during the dives carried out as part of their survey, including the deep-snouted pipefish *Syngnathus typhle.*

2.2 WATER QUALITY

Whilst seagrass can play an important role in improving water quality, water quality is also an important factor in determining the condition of seagrass beds. Nutrient enrichment may lead to excessive growth of certain algal species, potentially compromising the health of seagrass by overlying and smothering them (WFD-UKTAG, 2014). Jones and Unsworth (2016) report that Studland Bay was found to have nitrogen (N) and phosphorus (P) levels above the global average. Natural England (2023) state: "Data collected in 2013 tracked the nitrogen isotope δ15N, which is indicative of a human sewage and livestock effluent, in the leaf tissue of seagrass collected from Studland Bay. The findings classified Studland Bay with an Anthropogenic Impact Score of 4 and rated the seagrass beds health status as Moderate (out of Poor, Moderate or Good). This was attributed to the high levels of the δ15N isotope present in the leaf tissue of the seagrass, and the significantly lower above-ground biomass, seagrass cover, shoot biomass, leaf length, and leaf width than at sites considered 'Good'. The risk of eutrophication across the site has been assessed as low using the Environment Agency's Weight of Evidence approach."

Whilst no biological indicators of eutrophication are currently present at this site, evidence from monitoring suggests that nitrogen may be impacting the site at some level and further monitoring is needed (Natural England, 2023). The Environment Agency regularly monitors the Dorset/Hampshire

waterbody, which incorporates the Studland Bay MCZ, however the sampling location for the waterbody is located 7km to the south-east of Studland Bay (NGR SZ1119879772). More localised data is required and has been incorporated into the seagrass surveys undertaken by the Environment Agency and Natural England in 2022.

Since 2017 the National Trust have undertaken quarterly water quality monitoring at Manor Farm, a tenanted farm located in Studland. The results vary seasonally but at times show Nitrate levels to be indicative of high-very high pollution. The water from these sites flows into Studland Bay, near to the densest seagrass beds.

2.3 BOAT ACTIVITY AND DISTURBANCE

The impact of boat activity upon the condition of the seagrass in Studland Bay has been recognised by multiple surveys over the years. Teams from the University of Southampton have been monitoring Studland Bay since the 1990s. Damage to the seagrass originates from both swing moorings and anchor chains as larger vessels rotate around the anchor point causing a chain to scour the seabed. This causes mechanical damage which can uproot seagrass shoots and rhizomes and bury seeds too deep in the sediments for them to germinate successfully (Collins et al., 2010; Doggett and Northern, 2023). As seagrass cover is reduced this can also increase sediment mobility, which in turn may decrease the seagrass growth rate. It also affects the attenuation of current and wave energy. Collins *et al.* (2010) argue that the results from their own research and studies from different locations suggest that recovery from such damage is far from straightforward, and that the impacts of anchoring and mooring could potentially lead to the decline of the Studland Bay seagrass habitat and its associated species. The scars left behind can often be visibly seen in satellite imagery from Google Earth around fixed moorings. Impacts from the dragging of smaller anchors, or those deployed temporarily, is likely to cause damage on a much smaller scale and is not visible on satellite imagery. The significance and cumulative impact of this is less clear compared to the damage caused by fixed moorings.

There has been a lot of sporadic and anecdotal evidence of boat activity within the MCZ provided over the years, but little has been formally recorded, with the exception of a limited study by the ecological survey company, SeaStar (2012) and data collected by The Seahorse Trust and Southampton University during their studies on the site. Volunteers from the Seahorse Trust have often counted the number of vessels, but it is extremely difficult to do so on busy days with boats continuously coming in and out of the area. These counts do however provide valuable snapshots of usage and show just how popular the bay is with boat users, with 420 vessels counted on one busy day in 2019.

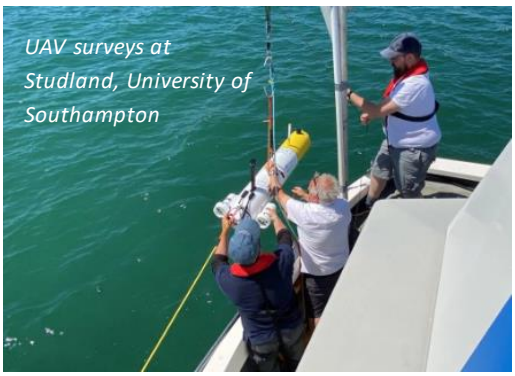
The SBMP recognised the need for a more formal monitoring strategy to understand not only the amount of boat traffic in the area but also to monitor the use of the eco-moorings and compliance with the VNAZ. The National Trust are currently trialling trail cameras set on a time lapse to provide this data. One camera has been installed on Ballard Down to monitor the east of the VNAZ (figure 2) and another camera is due to be installed ready for the start of the season in 2024 to monitor nearshore activity in the western extent of the VNAZ. Data is yet to be analysed but it is hoped that this consistent approach will provide a long-term understanding of boat activity and compliance in the bay.

Figure 2: Images from the boat monitoring cameras installed by the SBMP of the eastern end of the Studland Bay VNAZ. These were taken during a hot weekend in June when boat traffic in the area was high, however the busiest area of the bay nearshore is unfortunately just out of view. The eco-moorings are all in use on the right-hand side of the image, including overnight.

In June 2023, the Seahorse Trust helped to install 4 hydrophones onto the eco-moorings as part of a joint project between Natural England and the University of Plymouth. The purpose of the project is to better understand how noise from boat traffic impacts seahorses and invertebrates in the seagrass. The report is due to be published later in 2023.

2.4 ECO-MOORINGS IMPACT

Researchers from the University of Southampton have undertaken annual monitoring of the seagrass beds around the 10 initial eco-moorings installed by the Seahorse Trust and Boatfolk in 2021 (figure 3). The monitoring programme utilised multiple survey techniques, both visual and acoustic, to produce a high-definition map of seagrass density around the eco-moorings. The monitoring programme has provided invaluable data for the SBMP by demonstrating no detectable impact of the eco-moorings on the seagrass or seabed (Collins *et al.,* 2022).


UAV surveys at Studland, University of Southampton

An exciting development since the start of the programme has been the additional use of autonomous survey craft. In July 2022 another team of researchers from the University of Southampton tested a range of autonomous systems for mapping the seagrass beds in Studland Bay (Massot-Campos *et al.*, 2023). This project, funded by the Southampton Geospatial initiative and the Southampton Marine and Maritime Institute, involves deploying autonomous vessels capable of mapping the seagrass bed using cameras and acoustics. The team mapped the distribution of seagrass around 10 eco-moorings. Approximately 10,000 stereo image pairs were gathered from an altitude of 1 m along transects totalling 2.95 km. The images were then classified according to the density of seagrass using a location-regularised semi-supervised deep-learning method developed at the University. The key advantage of Autonomous Underwater Vehicles (AUVs) over traditional methods is their ability to cover kilometre-scale regions and make millimetre-resolution observations. Furthermore, their ability to precisely revisit regions of the seafloor allows damage and recovery time to the seagrass beds to be accurately documented.

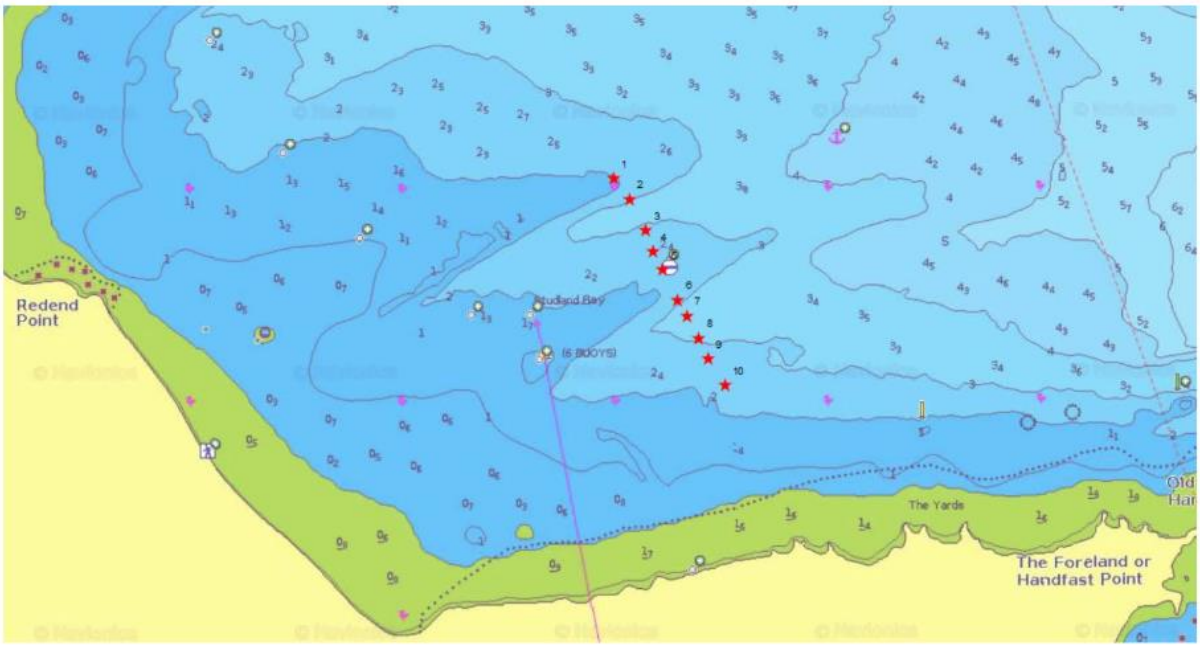


Figure 3: Location of the 10 initial eco-moorings installed by Boatfolk and the Seahorse Trust in 2021 (Collins et al., 2022).

2.5 COASTAL DYNAMICS

Coastal process monitoring is provided by the Channel Coast Observatory (CCO), also known as the Southeast Regional Coastal Monitoring Programme. The programme is managed on behalf of the Coastal Groups and is funded by DEFRA, in partnership with the maritime Local Authorities and the Environment Agency. Realtime and historic wave data (since 2003) is available from a buoy located off Boscombe Pier in Poole Bay, approximately 10km northeast of Studland Bay. This provides a valuable record of wave dynamics, sea surface temperature and storm events. The nearest meteorological station is located at Swanage Pier, approximately 3km south of Studland Bay on the south side of the Ballard Down headland. The CCO also provide other types of data in the bay including bathymetric data, habitat mapping, and topographic data. The SCOPAC Sediment Transport Study (2017) provides an excellent overview of sediment dynamics within Studland Bay, and further information of coastal processes can be found in the Shoreline Management Plan 15 (2011). The National Trust has undertaken its own limited coastal monitoring at Studland to inform local coastal adaption projects, including mapping of the strandline and dune/cliff toe and fixed-point photography. It has also commissioned reports undertaken by external consultants modelling erosion rates and undertaking risk analysis for coastal adaption projects at Middle Beach, Studland. All of this data can be utilised to help understand the conditions within the MCZ that may have an impact on the condition of the seagrass beds, as well as on boat activity within the bay.

2.6 CARBON SEQUESTRATION AND OTHER RESEARCH PROJECTS

Studland Bay is one of seven study sites included in the ReSOW Project (Restoration of Seagrass for Ocean Wealth). The project will facilitate informed management and restoration of seagrass for sustainable social, environmental and economic net gains. Specifically the project has undertaken research in areas such as carbon sequestration, fisheries and biodiversity, and the role of social and governance structures in restoration projects. It is hoped some of the first publications from this work will be available in Spring 2024. Research teams from Bournemouth University have also undertaken a significant amount of research in the bay, and have gathered data on carbon, fish and infauna biodiversity. It is also hoped that this work will be published in the near future.

2.7 SUMMARY

Table 1 provides a summary of all known monitoring surveys undertaken on the seagrass beds in Studland Bay.

Table 1: Summary of monitoring surveys of the Studland Bay seagrass beds prior to 2023, adapted from Doggett and Northern (2023).

Year(s)	Methods	General Aims (not exhaustive)	Reference
2008-present	Tagging	Seahorse surveys	Garrick-Maidment *et al. (*2010)
2009 – 2011	Transects and quadrats to monitor anchor scars and shoot density	Investigate impacts from anchoring and mooring	Axelsson *et al.* (2010); Seastar (2012)
2009	Video sledge and side scan	Investigate impacts from anchoring and mooring	Collins *et al.* (2010)
2012	Historical data review	Investigate impacts from anchoring and mooring	Jackson *et al.* (2012)
2013 – 2015	Diver records	Record marine life	Seasearch Dorset (2013; 2014; 2015)
2014	Quadrats	Collect measurements of shoot density, percent cover, leaf length, epiphytes and measurements of C, N and P	Jones and Unsworth (2016)
2016	Core sampling and quadrat surveys	Sediment carbon measurements with additional quadrats to record shoot density	Green *et al.* (2018)
2018	Drop camera and echo sounder	Map bed extent and seagrass percentage cover	Green (2018)
2021	Quadrats and shoot sample analysis	Comment on overall health and function, as well as species composition of characteristic biological communities.	Doggett and Northern (2023)
2021-present	Echo sounder and quadrat surveys	Impact of ecomoorings	Collins *et al.*(2022)
2022	Autonomous underwater vehicle	Impact of ecomoorings	Massot-Campos *et al.* (2022)
2022	Drop camera and echo sounder	Map bed extent and seagrass percentage cover	TBC
2022	Seine netting (fisheries)	Assessment of fisheries and biodiversity with seagrass meadows to create a UK Seagrass Fisheries Residency Index	TBC

3. BASELINE CONDITION

A formal condition assessment of the Studland Bay MCZ by Natural England is due to take place before the end of 2023. At the time of designation, DEFRA (2019) stated that the general management approach for the seagrass beds should be to 'recover to favourable condition'; whereas the approach for other protected features of the site (intertidal coarse sediment; long-snouted seahorse; subtidal sand) is to 'maintain in favourable condition'.

As part of the monitoring programme Doggett and Northern (2023) were asked to make any comments regarding their assessment on the condition of the seagrass beds feature. Discussing the 2021 surveys, the authors stated: "Density and percent cover values from previous surveys cannot be compared statistically due to the different methods used. Considering this, the values cited between surveys are broadly in range with the current study, suggesting that the overall density / percent cover of the seagrass, where it was surveyed, has not changed significantly and has likely been maintained". Until the latest results from the 2022 surveys and the formal condition assessment are available, the SBMP will utilise the data provided by Green (2018) as a baseline for extent and percentage cover (figure 1). This data can be used in combination with the extensive and high-resolution data provided by the various studies carried out by the University of Southampton and other research institutions (including Collins *et al.* 2022; Massot-Campos *et al.* 2022).

A comprehensive review of historical data and images of the seagrass beds was undertaken by the Marine Management Organisation and Natural England (Jackson *et al.* 2012) that demonstrated the fragmentation of the seagrass beds due to anchoring impacts, as also noted in more recent on-site surveys. Ongoing monitoring of the impact of eco-moorings by Collins *et al.*(2022) and Massot-Campos *et al.* (2022) demonstrates that the installation of the eco-moorings has had no detectable detrimental impact on the seagrass or seabed. It is hoped continued high-resolution mapping of the moorings will enable documentation of the recovery of the fragmented seagrass.

4. MONITORING PLAN

The Seagrass Restoration Handbook (Gamble *et al.*, 2021) suggests that a long-term monitoring strategy (> 5 years) that considers both structural (e.g., seagrass cover) and functional (e.g., biodiversity) metrics is essential to determine whether a restoration project has been successful. The metrics presented here focuses on these categories as well as including monitoring of human activities and coastal dynamics that impact the recovery and condition of the seagrass beds. As discussed in section 2, many of these metrics are already being monitored, or have been in the past, by the extensive research and monitoring programmes already undertaken in the bay. For this reason, we have distinguished in this plan what monitoring is already being undertaken by our partners to help provide evidence to support our project (table 2) and what monitoring is to be directly undertaken by the SBMP as part of the eco-moorings project delivery (table 3). Both the direct and indirectly collated evidence from our partners will be critical in order to assess the progress of the SBMP's 10-year restoration strategy and the overall health of the seagrass beds. In line with the strategy, initially the plan focuses on monitoring the impact of the eco-moorings and VNAZ on the seagrass. However, it is hoped this programme will also help to identify further research opportunities within the broader Studland Bay MCZ.

Table 2: Evidence collated from SBMP partners to support the overall monitoring of the Studland Bay MCZ.

	Who: lead delivery partner(s)	When: season, regularity	Where: spatial extent	Methods	Outputs and data rights	Comments
Structural						
Cover/Extent	Natural England/Environment Agency	1 survey every 3 years during summer; can be more frequent if needed	Southern seagrass bed	Drop camera, dive surveys	Reports and data produced by NE/EA	Recommended to include northern bed next to Training Bank in future monitoring.
	HydroSurv (partnered with University of Plymouth)	2022-2023 Studland used as demo site. Could repeat if needed	Southern seagrass bed	Uncrewed Surface Vessel	UoP / EA	Provides good spatial coverage in relatively short space of time.
Shoot density	Natural England/Environment Agency	1 survey every 3 years during summer	Southern seagrass bed	Diver surveys	Reports and data produced by NE/EA	Additional shoot density data undertaken by regular University of Southampton surveys.
Disease assessment	Natural England/Environment Agency	1 survey every 3 years during summer	Southern seagrass bed	Diver surveys	Reports and data produced by NE/EA	
Invasive species	Natural England/Environment Agency	1 survey every 3 years during summer	Southern seagrass bed	Diver surveys	Reports and data produced by NE/EA	Note to monitor growth of invasive algae on the marker buoys and moorings.
Functional						
Biodiversity (including seahorses)	Seahorse Trust	Annual regular surveys to be undertaken for at least 10 more years	Southern seagrass bed	Diver surveys, tagging	Reports and data produced by SHT	Moving forward need to decide how to make annual datasets directly comparable to compensate for differences in survey hours. Also to include set transects in the bare sand between the seagrass beds and South Beach shoreline.

Water quality	Natural England/Environment Agency	Annual	Currently 7km outside of Studland Bay but localised site was included in latest survey.	N and P	Reports and data produced by NE/EA	Need for localised data moving forward.
	National Trust	Seasonal monitoring	Manor Farm runoff into Studland Bay	Water temperature and Dissolved Oxygen were recorded in situ and a sample was collected for later analysis. Collected samples were analysed for Nitrate, Phosphate, Iron, pH and Conductivity	Annual report and data produced by NT	Potential for static monitoring to collect data in real time.
Carbon stock	Bournemouth University	Surveys in 2021, no plans to repeat at present			Paper to be produced by BU	Surveys in 2021 also included biodiversity infauna. Might not need routine carbon surveys to support SBMP project as value of carbon sequestration not as great as other ecosystem service benefits.
Human activity						
Boat activity	National Trust	Daily, March – November, for duration of project	VNAZ	2 x time lapse cameras on Ballard Down, images recorded every 6 hours. Boat numbers and VNAZ compliance, eco-mooring use.	Photos stored on NT system until analysed. Annual numbers produced by NT	Trial system; would be improved with use of Wi-Fi to allow remote access to images. Still finding spot for 2nd camera prioritise getting someone to analyse photos. SHT have also done regular informal boat counts, have done since 2008

Noise pollution	University of Plymouth, Environment Agency, Seahorse Trust	Summer 2023 but could repeat	4 eco-moorings	Hydrophones record for 2 weeks	University of Plymouth	Report due September 2023 Group agree important to include this looking forward
External conditions						
Coastal Dynamics and Meteorological conditions	Channel Coast Observatory	Annual	Poole Bay/Swanage	Wave buoys; weather station	Data and reports produced by CCO	Not monitored explicitly by the project but utilised to help understand our data

Table 3: SBMP Seagrass Restoration Monitoring Plan – Metrics monitored directly by SBMP to support the delivery of the restoration strategy

Metrics	Who: lead delivery partner(s)	When: season, regularity	Where: spatial extent	Methods	Outputs and data rights	Comments
Cover/Extent and shoot density	University of Southampton	Annual in summer. Review after 2025	10 eco-moorings (see figure 3)	Side scan sonar, acoustic vegetation height, video sledge, diver quadrat and video surveys, AUV (2022 only)	Reports and data produced by UoS	
Invasive species	Natural England/Environment Agency	1 survey every 3 years during summer	Southern seagrass bed	Diver surveys	Reports and data produced by NE/EA	Note to monitor growth of invasive algae on the marker buoys and Bankes Arms moorings in future surveys
Seahorse population	Seahorse Trust	Annual regular surveys to be undertaken for at least 10 more years	Southern seagrass bed	Diver surveys, tagging	Reports and data produced by SHT	
Boat activity	National Trust	Daily, April – November. Review after 2025	VNAZ	2 x time lapse cameras on Ballard Down, images recorded every 6 hours. Boat numbers and VNAZ compliance, eco-mooring use.	Photos stored on NT system until analysed.	

5. SUMMARY AND NEXT STEPS

The incredible marine environment of Studland Bay provides a fantastic opportunity to learn more about how we can protect and restore our seagrass meadows and the multiple benefits that this ecosystem provides. This document highlights the extensive range of research that has been undertaken in Studland Bay to date, and what monitoring is required in order to support the SBMP's 10-year restoration strategy. As summarised in section 4, the metrics that will be specifically monitored by the SBMP includes: (1) seagrass cover and condition around the eco-moorings; (2) the presence of invasive species including on moorings and marker buoys; (3) Seahorse population and distribution; (4) Boat activity and compliance within the VNAZ. Now these metrics have been identified, the next step for the RMG is to refine the methodologies with the lead partners for each metric, as well as outlining what funding is required to deliver the monitoring plan. Some funding has already been secured to continue this monitoring through to spring 2025; at which point there will be a review to determine what monitoring needs to continue and whether any new opportunities for further research has been identified.

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ABBREVIATIONS AND DEFINITIONS

Eco-mooring - Eco-moorings offer an environmentally friendly alternative as a helical screw anchor is installed into the seabed. An elastic rode is then attached, connecting the anchor system with the mooring buoy. The elastic rode will stretch at higher tides and contract at lower tides, so the equipment does not damage the surrounding seagrass. advanced-mooring-systems (rya.org.uk)

MCZ – Marine Conservation Zone Marine conservation zone designations in England - GOV.UK (www.gov.uk)

MMO – Marine Management Organisation

RMG – Research and Monitoring Group of the SBMP

SBMP – Studland Bay Marine Partnership (Studland Bay Marine Partnership | Dorset Coast Have Your Say)

Seagrass bed - OSPAR (2009) states that to "qualify as a Zostera 'bed', plant densities should provide at least 5% cover. The beds in Studland Bay consist of one of the two species found in UK waters, *Zostera marina.*

SRH – Seagrass Restoration Handbook (Gamble *et al.,* 2021)

VNAZ – Voluntary No Anchor Zone Studland Bay Voluntary No Anchor Zone - 2022 Review - GOV.UK (www.gov.uk)

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