Cornwall Wildlife Trust

NATURAL ENGLAND

G7 United Kingdom 2021

St Austell Bay blue carbon habitats Project update 2023-24

Part of the G7 Legacy Project for Nature Recovery

Report information

St Austell Bay blue carbon habitats project 2023-24

Part of the G7 Legacy Project for Nature Recovery

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Cornwall Wildlife Trust report

Cover and reverse photos by Matt Slater

Executive Summary

G7 legacy funded research continued in St Austell Bay in 2023 to discover more about the marine habitats and wildlife, there were four project areas: acoustic mapping of maerl beds, dive surveys to assess habitat health and diversity, a pilot eDNA study to assess this as a method for monitoring diversity and a water quality preliminary investigation.

The mapping project conducted further acoustic transects and drop-down video to produce a map of maerl habitat. An ecological consultancy, ENVISION were commissioned by Natural England to produce a map of predicted maerl habitat by using still images and video to ground truth the acoustic transects. The resultant map suggests a large area of maerl habitat (792 hectares). However the majority of this (94%) despite having greater than 20% overall maerl cover only had a small proportion of living maerl (less than 5% cover of live maerl) suggesting the maerl beds are under pressure and degraded, needing protection in order to recover.

Dive surveys found a wealth of marine life in the bay and at other sites along the south coast. Dives carried out by Cornwall Wildlife Trust Seasearch volunteers found living maerl at all but one dive site and recorded a total of 96 different species. Natural England undertook a series of dives at maerl sites along the south coast and into the Fal estuary to assess condition of maerl habitat. Despite lower percentage cover of live maerl on the St Austell beds the dive team found a comparable diversity of organisms living in the maerl to sites elsewhere in the study. This reflects what has been reported in research elsewhere, that even maerl with a low percentage of living cover is vitally important habitat for other species and can support a diverse ecosystem.

The eDNA pilot study proved that this is a useful complementary addition to other methods for surveying species with this initial focus being on fish. In total 33 species were identified which included commercially important species such as pilchards, mackerel and seabass and additionally several on the IUCN Red list including cod, whiting, and pollack - all species with “zero-catch” scientific advice. Interestingly giant gobies were detected at two sites, these are recognised as a rare species in Britain and are protected under schedule 5 of the Wildlife and Countryside Act.

The water quality project trialled new real time monitoring technology, collated existing datasets and investigated the use of seagrass as a water quality indicator. The WTR buoy real-time monitoring system trial demonstrated this as a useful monitoring tool which will enable temporal pinpointing of pollution events and spatial if more can be deployed. Some areas of concern included: periods of low dissolved oxygen and frequent sewage releases through Combined Sewage Outflows (74 spill events in 2022) which were evidenced in the historical datasets and also possible evidence of nutrient enrichment and elevated turbidity from the seagrass investigation.

The results show an area of rich marine habitats and diverse wildlife. However, there are still many gaps in our current knowledge about how human activity is impacting marine life and habitats in the bay. Maerl beds are damaged, and there are concerns with water quality suggesting significant action is needed to protect and restore this beautiful area for future generations.

Contents

Introduction

G7 Legacy Project for Nature Recovery

The G7 Legacy Project for Nature Recovery (G7 LPNR), which was announced by the then Prime Minister, Boris Johnson, at the G7 Summit in June 2021, is an ambitious nature recovery project looking to deliver a legacy for wildlife, climate, and people in Mid-Cornwall (see figure 1).

Cornwall Wildlife Trust and Natural England facilitated the project in partnership, knitting together joint working for the restoration of land and sea and the species which exist there.

Defined as a 5-year project, the aims are to:

- Create new,nature rich land and sea, as well as connecting and restoring sites, species, and landscapes.
- Capture approximately 440,000 tonnes of carbon dioxide through its work.
- Improve access to green and blue spaces to engage and empower local communities to work with nature for health, wellbeing, and future resilience.
- Bring together a range of industries and stakeholders to drive green and blue initiatives across the catchment.

This is a legacy project, looking to ensure sustainable nature recovery for years – not just for the life of the G7 project.

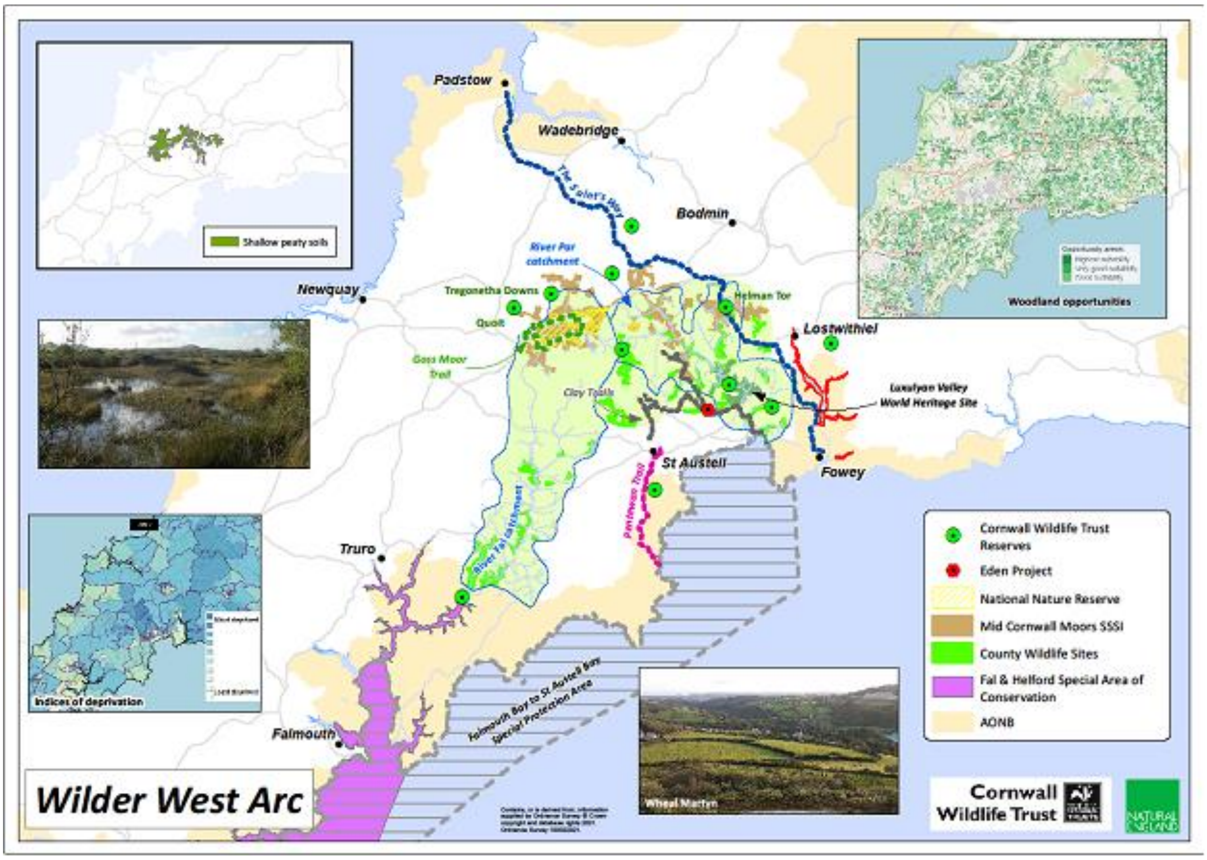

Figure 1: G7 Legacy project for Nature Recovery Project area map

The St Austell Bay blue carbon project aims to address the LPNR aims within the project coastal catchment waters, from St Austell Bay itself but also the connecting south to Veryan and Gerrans bays. Healthy marine habitats are important for biodiversity but also key to improving ecosystem resilience to climate change and providing natural solutions that reduce carbon emissions. In the first instance it is critical to have accurate baseline information on the extent and condition of these habitats so appropriate action can be taken to protect them.

In 2022 the project aims were to produce accurate maps on the extent and condition of the seabed habitats in the area by:

- Mapping existing and historical datasets in partnership with the Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS).
- Boat surveys using Biosonics echosounder techniques for blue carbon habitats focusing on seagrass and maerl.
- Dive surveys for condition assessment and ground truthing.

St Austell Bay mapping project results summary from 2022

Historic data was successfully collated and mapped and used to suggest optimal positions of exploratory dives. In 2022 acoustic and video surveys produced detailed maps of seagrass habitat in St Austell Bay and Gerrans bay. These covered a larger area than expected especially in St Austell Bay, where the seagrass bed covered approximately 360 hectares (see figure 2) compared to 104 hectares mapped previously.

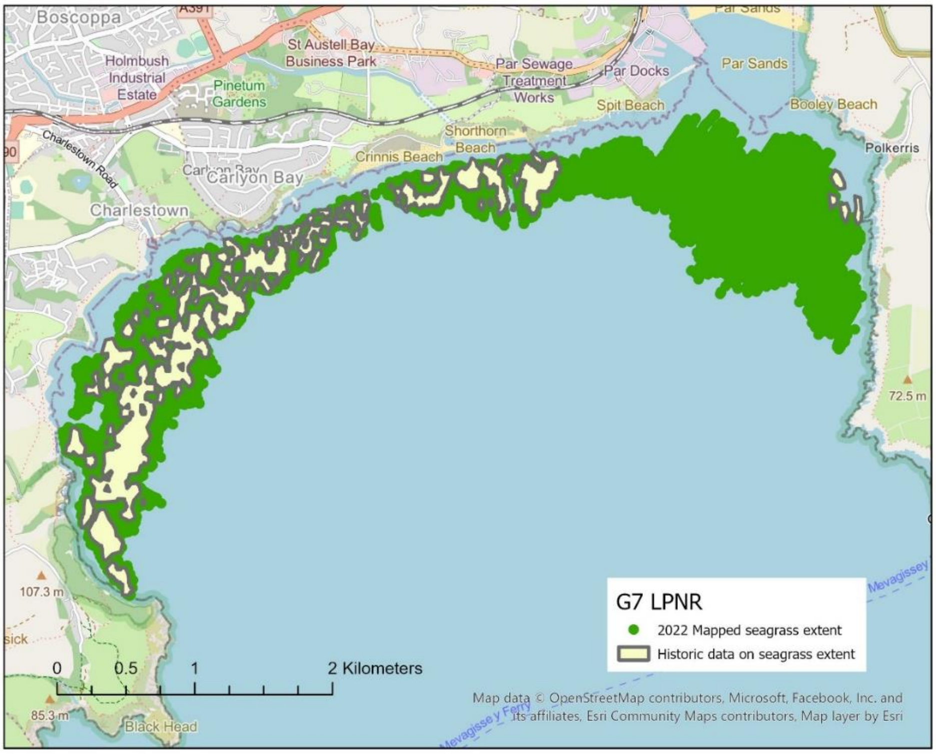

Figure 2 Current extent of seagrass habitat in St Austell Bay compared to historical data (2016 National Seagrass Layer).

Seasearch dive surveys were conducted to explore habitat existence, condition and diversity at 11 sites. These revealed maerl and seagrass habitats rich in animal and plant life, 56 species were identified in seagrass and 66 on maerl beds. Highlights included a short-snouted seahorse, tub gurnard, and scallops.

Due to limitations of budget, time and poor weather conditions the acoustic survey of Veryan bay was not completed and no dives were carried out in Gerrans bay.

For a full introduction to the G7 project and marine nature recovery and details on the seagrass surveys conducted please see the St Austell Bay Blue Carbon Mapping report (Crosby et al., 2023).

St Austell Bay 2023 project update

In 2022 we discovered a great deal about the extent and health of the seagrass beds in the bay. However much of the bay remained un-mapped and we still needed to learn about the condition of the seagrass and other habitats and discover what might be impacting on them to inform conservation efforts. In 2023 the survey work focused predominantly on another precious and irreplaceable habitat: maerl.

About Maerl

Maerl was officially classified by Natural England in 2022 as an 'irreplaceable habitat'. It is a slow growing, free living, calcified red seaweed which lives in shallow water and forms 3D structured layers on the seabed, known as 'maerl beds' which can cover large areas under the right conditions (Tillin et al., 2022).

Maerl forms as unattached nodules known as rhodoliths (see figure 3). These grow extremely slowly with the tips of the rhodoliths in UK species producing between 0.5 to 1.5mm new growth per year. The living maerl sits on top of layers of dead maerl which builds up over time (centuries or millennia) to form the bed. It takes a very long time therefore to form a bed and some of these around the UK are 1000s of years old (Blake et al., 2007).. This complex, 3D structure provides small living spaces and refuges for a myriad of life (see figure 4). As a result, maerl hosts a diversity of species including many commercially important ones. It can be key spawning habitat for species like herring, and provides shelter for juvenile scallops, bass, cod and pollack amongst many others (Frost & Diele, 2022; Kamenos et al., 2004).

Several species of free-living coralline algae can form maerl beds. In Cornwall, there are thought to be two known species – *Phymatolithon calcareum* and *Lithothamnion corallioides* – which occur along the south coast of the county, particularly within the Fal and Helford Estuary and, as only discovered fairly recently, St Austell Bay (Jenkins et al., 2021).

The slow growth of maerl beds makes them extremely vulnerable due to the length of time it takes to recover from destructive activities. Both species are listed as 'vulnerable' on the European Red List of habitats as well as being recorded in the OSPAR list of threatened and/or declining habitats. Because of this and due to its biodiversity importance and rarity in the UK, maerl beds are classified by Natural England as 'irreplaceable habitat' and are a habitat and species of 'principal importance' in England (Axelsson, 2023; Tillin et al., 2022).

Research has also found that maerl beds (especially healthy ones) can store large quantities of blue carbon (Mao et al., 2020; Sheehy et al., 2024) both within the tissue of the maerl itself and through the burial of organic material that lands on the bed. If significant areas of maerl beds are established, as found in the South West of the UK, they will play an important blue carbon role in our shallow seas.

Figure 3 Maerl bed in the Fal estuary showing large healthy rhodoliths.

Figure 4 Maerl bed in the Fal estuary, photo credit: Matt Slater

Project work in 2023

As our previous report indicated there is still so much we need to learn about our coastal seas in order to provide adequate protection. Most of our coastal seabed habitats remain unmapped, let alone assessed for health. In the meantime, whilst the pressures from climate change and human activity continue to increase, we have little measurement of the impacts these are having on marine life and habitats. This information is vital for proper protection of our coastal seas. As healthy oceans are important for human health and well-being and, especially in Cornwall, our economy, it is in the interest of all to ensure our coasts are adequately understood and monitored.

Therefore, in order to progress our understanding of St Austell Bay habitats, and to investigate some of the pressures on it (addressing some of the recommendations from the G7 blue carbon report) four projects were undertaken in 2023:

- Detailed acoustic and drop-down video surveys of St Austell Bay to map maerl beds.
- Further dive surveys to assess diversity and health of maerl and seagrass beds within St Austell Bay.
- Pilot eDNA analysis to investigate fish diversity at maerl sites.
- Pilot water quality investigation.

Acoustic and video mapping of maerl beds

The aim of the mapping activity in 2023 was to identify the distribution, extent and range of subtidal maerl communities within St Austell Bay using acoustic data, ground-truthed by drop-down video (DDV). Cornwall Inshore Fisheries and Conservation Authority (CIFCA) were commissioned to carry out this survey work. The visual data from the DDV is used to confirm the habitat signatures from the much wider acoustic survey (see figure 4) which illustrates the modelling process. Due to poor weather in autumn 2023 survey work was only partially completed and then finished in late spring of 2024 .

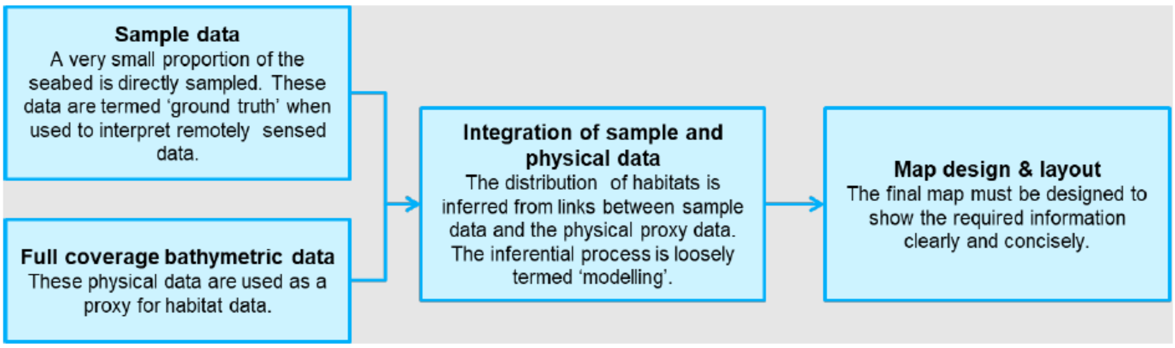

Figure 4 A flow chart of the main stages in making a habitat map by integrating sample data and full coverage physical data (from Turnbull et al., 2024).

CIFCA's research vessel (Tiger Lily VI) was used to conduct three days of acoustic surveys to cover nearly 100% of St Austell Bay using an EdgeTech 4200 Side Scan Sonar. In total, 31, 200 metre swathe survey lines were completed covering the area from Black Head to Gribbin Head and inshore to Carlyon Bay (see figure 5). They returned in April 2024 to conduct video transects using a STR SeaSpyder drop camera system. In total, video and still imagery was taken at 45 sites across the bay (Turnbull et al., 2024). Extensive ground truth imagery is needed for maerl mapping compared to habitats such as seagrass and kelp, as its acoustic signature is very similar to other similar habitats, such as gravel.

The environmental consultancy ENVISION were then commissioned and funded by Natural England to carry out analysis of the still images and video footage collected. This included imagery analysis to provide information on species composition of maerl bed benthic fauna, with particular focus on the percentage cover of live and dead maerl, classified using the maerl categorisation system (Axelsson, 2023) along with interpretation and classification of the acoustic and imagery data. The results were used to create a model of the distribution of maerl habitat, resulting in an updated map of predicted extent (see figure 6).

The combined results, from both acoustic and image analysis data, show a large extent of maerl bed covering 792 hectares within St Austell Bay. For much of this, (the light pink areas in figure 6) although total maerl cover is greater than 20%, the live maerl is less than 5% cover, which suggests the habitat is under significant pressure and needs protection to recover. There are pockets of healthier maerl (just over 50 hectares in total) with a greater than 5% live cover (see figure 6). However even maerl beds with little living cover can still provide similar function to healthier beds due to the structure of the rhodoliths (Sheehan et al., 2015).

The current mapping process is likely to have some bias as many of the ground truth samples were on maerl habitats. ENVISION report that, because the data used to train the model was predominantly of maerl, it may overestimate the distribution of the beds. In addition, some of the data (bathymetry and video data) was of poor quality due in part to sea and weather conditions which again could affect the predictive quality of the model (Turnbull et al., 2024).

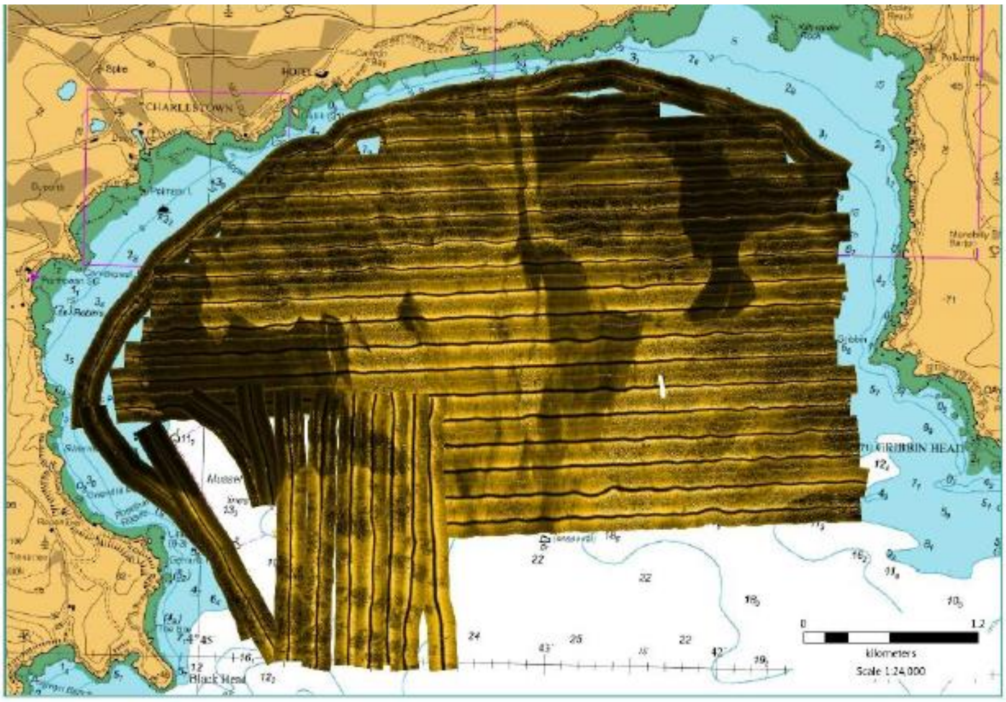

Figure 5 Acoustic transects in 2023 (Jenkin et al., 2024)

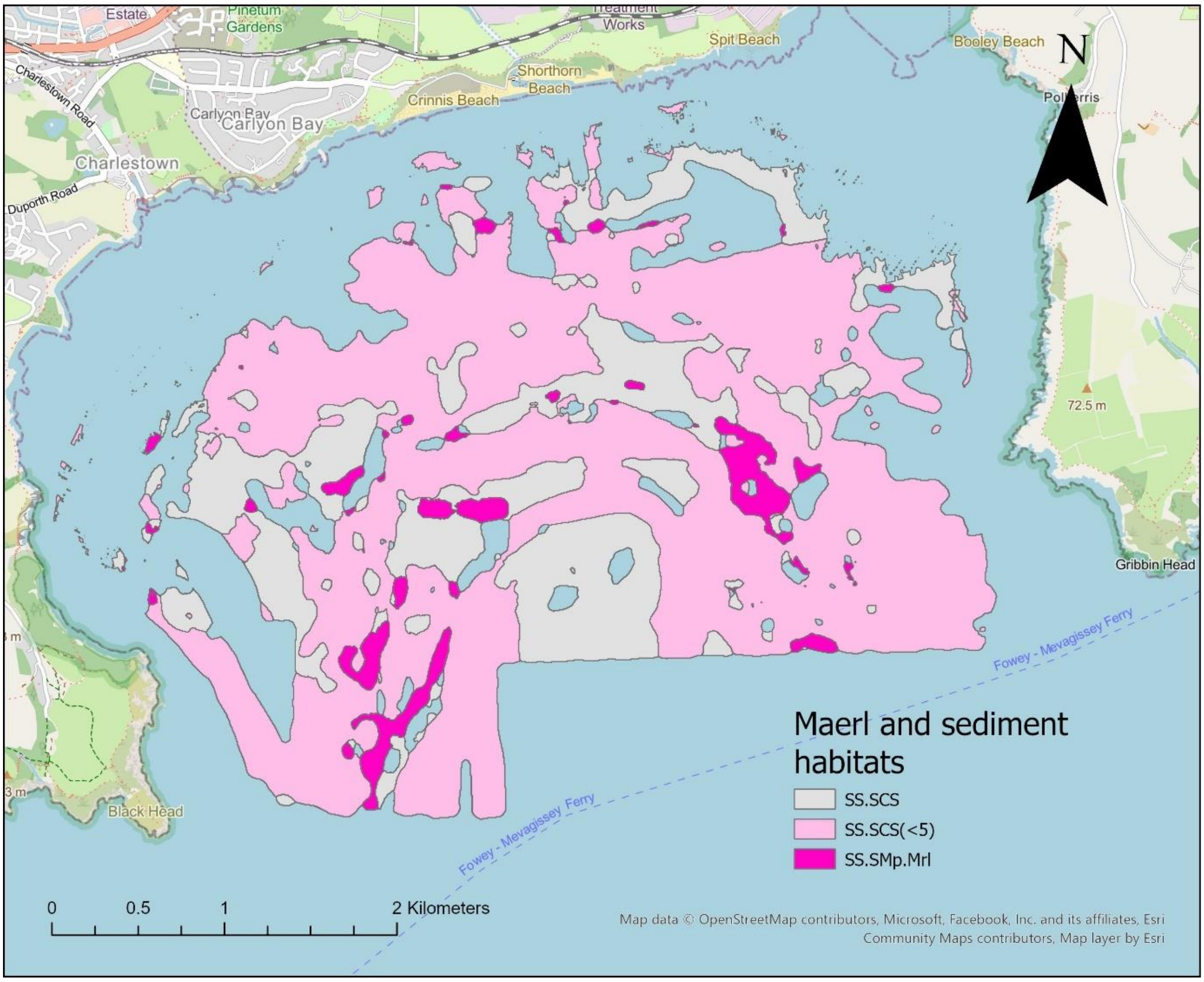

Figure 6 Modelled maerl habitat extent in St Austell bay. (Biotope codes: SS.SCS - coarse sediment no live maerl, SS.SCS(<5) - total maerl greater than 20% and live maerl less than 5%, SS.SMp.Mrl maerl greater than 20% and live maerl greater than 5%) source of data: Natural England.

Dive surveys

Two sets of dive surveys were undertaken in 2023. Cornwall Wildlife Trust coordinated Seasearch dives at six targeted sites to look for blue carbon habitats e.g. maerl or seagrass, and to assess the density and health of these habitats and the diversity of species associated with them. Additionally, Natural England conducted condition assessment dives of maerl beds at 16 sites across the Fal and Helford Special Area of Conservation (SAC) and the Falmouth Bay to St Austell Bay Special Protection Area (SPA). Three of the Natural England survey sites were within St Austell Bay itself.

Seasearch dive surveys

Six surveys were undertaken by experienced Seasearch trained divers in October 2023. The sites were chosen with the aim of investigating areas not previously dived, but that are known from acoustic survey results to have maerl and seagrass, and also to investigate areas which have not been surveyed by any method before. A variety of habitats were reported on the dives from kelp park to reefs and soft sediments, but maerl beds were encountered at five out of the six sites (including two sites which were outside of the known extent of the beds). Live maerl cover ranged from 3 – 20% (see figure 7). Two of the sites with live maerl were outside of the extent identified by the 2016 acoustic survey. In total 95 species were recorded across the six dive sites including kelp, cuttlefish, scallops, large sponges, wrasse, spider crabs, crawfish and lobsters (see figure 8). The divers reported that maerl occurred in wave formations, often with live maerl in the troughs (see figure 9) (Slater & Williams, 2024).

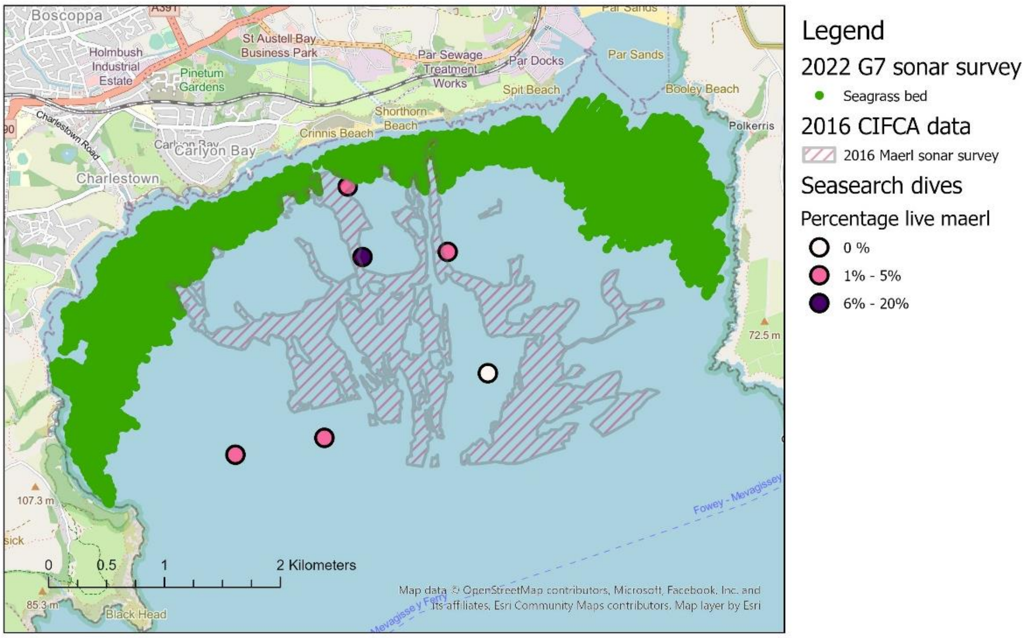

Figure 7 Seasearch dive sites in 2023

Figure 8 Wave formations of maerl, trough in foreground with large live maerl nodule in the centre. (Photo credit: Matt Slater)

Fig 9 Some of the rich marine life encountered in St Austell bay: Cuttlefish on the edge of the maerl bed (top right), two spot gobies around furbelows (top left), spiny starfish on derelict fishing gear (bottom left), Lobster and lost mussel ropes beneath mussel farm (bottom middle) and juvenile couches seabream (bottom right). (Photo credit: Matt Slater)

Natural England dive surveys

The Natural England Dive Unit undertook surveys of maerl beds at 16 sites across the Fal and Helford SAC and the Falmouth Bay to St Austell Bay SPA in September 2023. Community composition was recorded in replicate 0.25 m^2 quadrats along 20 m transects at each site (see figure 10). Substrate composition and percentages of live and dead maerl and total algal cover were also recorded. Further transects, 50 m long were used to collect additional data on the percentage cover of live and dead maerl, substrate composition and the size-frequency distribution of scallop populations. Three sites were surveyed within St Austell Bay shown in the map below (see figure 11).

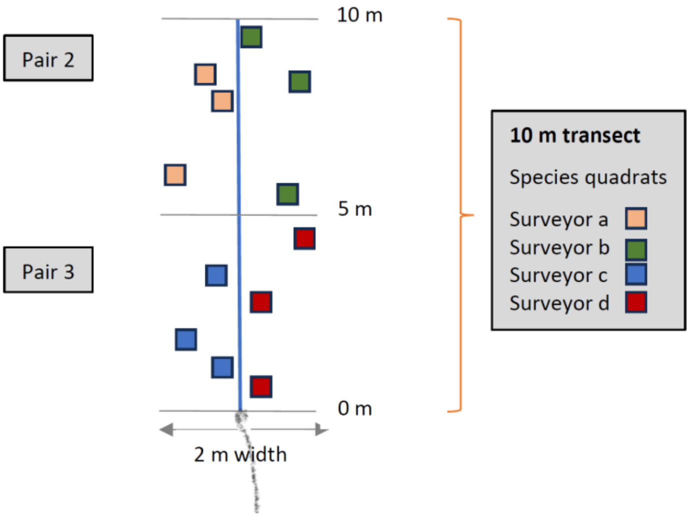

Figure 10 Dive transect with random quadrat placement (Doggett & Northen, 2023)

Live maerl was present at mean densities of approximately 70% within the SAC, and at approximately 30% in the SPA. Sites SAC04-06 over St Mawes Bank in the Fal estuary had dense, 3-dimensional, large maerl rhodoliths creating a structurally complex habitat; this supported a diverse range of sponges, crustaceans, molluscs and polychaete worms. Structural complexity was lower at the other SAC and SPA sites, but the faunal communities remained diverse. The three sites within St Austell Bay were the only ones which had a greater proportion of dead to live maerl, perhaps reflecting greater pressures on the bay, the beds formed waves with live maerl accumulating in the troughs (see figure 12). Despite this, the diversity of species found in the quadrat surveys in St Austell Bay (ranging from 45 to 71 species per site) remained comparable to other sites (mean species per site = 61) and the community composition (types of species present) was also similar (Doggett & Northen, 2023) reflecting other research which shows that even degraded maerl habitat is still ecologically important and supports a great variety of life (Sheehan et al., 2015).

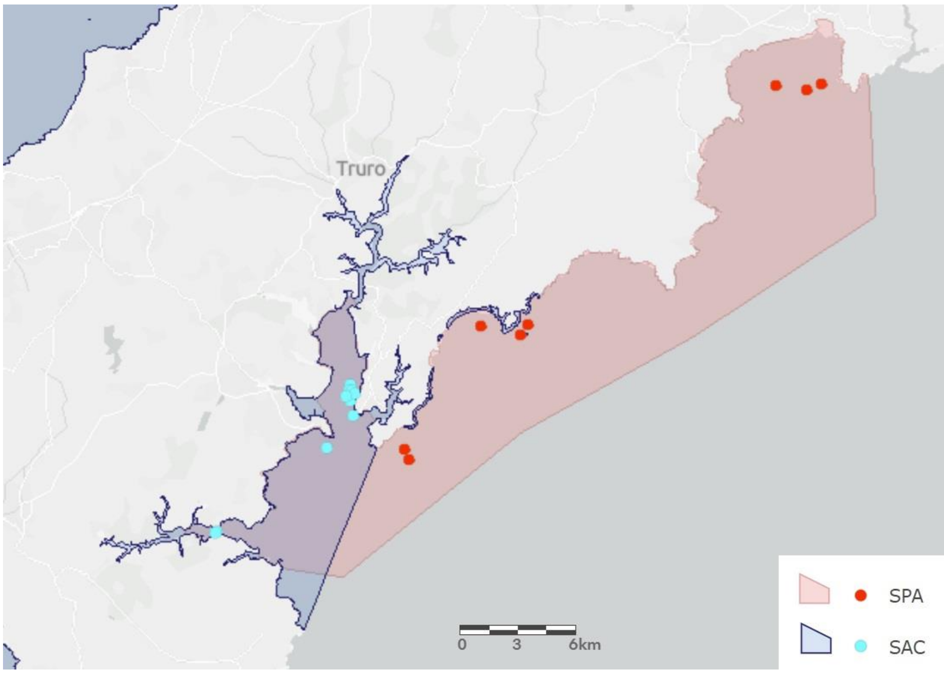

Figure 11: Natural England maerl survey dive sites, (Doggett & Northen, 2023)

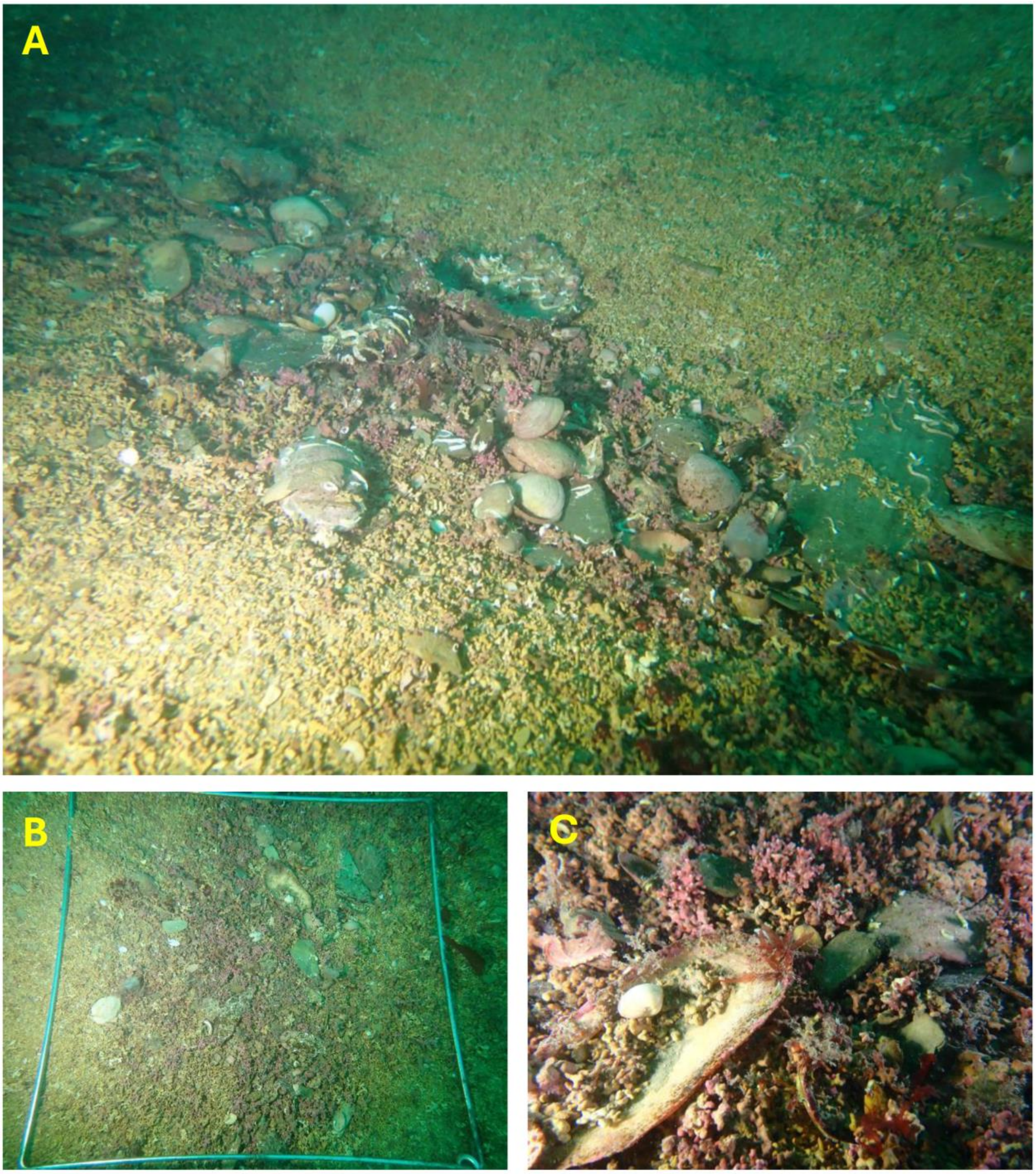

Figure 12: Survey site 25: St Austell bay : (A) Sediment waves and troughs across the seabed sediment plain with (B) and (C) live maerl accumulated in troughs. (From Doggett & Northen, 2023)

Pilot eDNA surveys

Environmental DNA (eDNA) works on the principle that all organisms passing through an environment are shedding or excreting matter containing their DNA. By taking a sample of that environment, the DNA it contains can be amplified and identified to discover which organisms are present (Miller, 2024; Rourke et al., 2022). Because most DNA breaks down in the environment after a few days a sample should only contain DNA of species which have been in, or passing through, the area recently. It is an increasingly popular method for rapid assessment of diversity in an area and is also useful for picking up rare or cryptic species that other surveys may miss. This pilot study was carried out by Cornwall Wildlife Trust with a specific focus to investigate which fish species may be using the seabed habitats in St Austell Bay.

Ten Niskin bottle samples were collected at approximately 4 metres above the seabed. The water samples were then filtered and sent off for extraction and analysis with NatureMetrics.

Figure 13 Deploying the Niskin bottle to take water sample at depth (left) packing sample to be taken back for filtering (right).

A total of 38 species were detected, 33 once screened for non-target taxa and a record of rainbow trout, likely originating from stocked lakes upstream of the White River that feeds into St Austell Bay (see figure 14). Of these 33 species, 16 were of commercial fisheries interest, including Cornish sardine (detected in abundance in all samples), common sole, Atlantic mackerel, and European seabass. Additionally, Atlantic cod (IUCN Red List: Vulnerable), European herring, whiting, and pollack were detected, all of which are species with “zero-catch” scientific advice. Notably, giant gobies were detected at two sites. These are recognised as a rare species in Britain and are protected under schedule 5 of the Wildlife and Countryside Act. The results highlight how important St Austell Bay is for fish and demonstrate the great potential of this method for rapid assessment of diversity as a complement to other survey methods.

Further survey work is required to build on the conclusions of this study, capture additional biodiversity and improve on the habitat resolving power of eDNA analysis. This can be done by increasing the total number of samples and introducing replicate samples taken at the same location. As a result, not only will the results of the eDNA analysis better represent the true species composition in St Austell Bay but might also allow us to draw conclusions about how fish species composition changes across the different habitats found in the area.

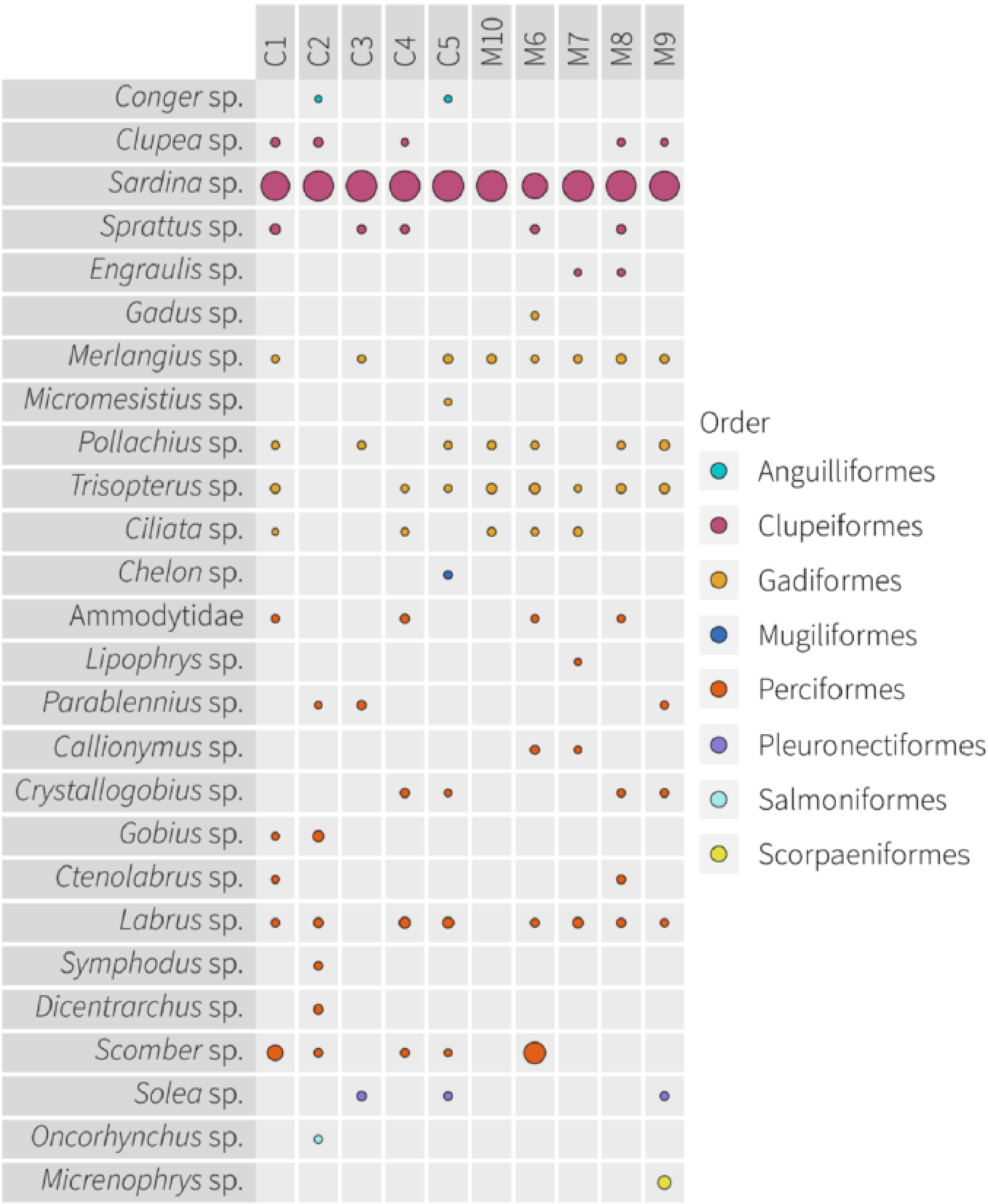

Figure 14 eDNA profiles of the 10 sites. Larger circles denote a stronger DNA signature (from Nature Metrics, 2024)

Water quality pilot project

Poor water quality is considered one of the primary threats to marine and coastal ecosystems' health and resilience, with anthropogenic pollutants being a key driver in declining water quality status (van Vliet et al., 2023). The increasing evidence for widespread impacts of wastewater, sewage pollution, and agricultural runoff on the marine environment is exacerbated by our changing climate (Pipe, 2024)

The Water Quality Pilot Project, conducted by Cornwall Wildlife Trust from October 2023 to March 2024, aimed to be the first step in building a baseline understanding of water quality in the St Austell Bay catchment. This was achieved through the following:

- Collection of real-time data using a marine water monitoring buoy.
- An evaluation of existing water quality datasets available including Environment Agency, and combined sewage overflow data from the Rivers Trust.
- St Austell Bay seagrass analysis conducted by an MSc student at The University of Exeter in collaboration with Cornwall Wildlife Trust.

(For an explanation of the water quality indicators used see appendix A).

Methods & Results

Real-time data monitoring pilot

A pioneering real-time marine water monitoring buoy created by WATR was deployed in St Austell Bay, anchored to an existing buoy on the mussel farm (thanks to Gary Rawle of Westcountry Mussels). The buoy contains instruments which record dissolved oxygen, temperature and turbidity every 30 minutes, with the data relayed to an online accessible dashboard.

The Watr buoy readings showed consistent values within the expected values of dissolved oxygen, indicative of healthy ecosystem functioning throughout the pilot monitoring period. (see figure 15). Turbidity however showed great variability and some unexplained spikes which exceeded expected turbidity values, as a result the sensor was removed in February 2024 for maintenance, the turbidity levels then returned to expected levels.

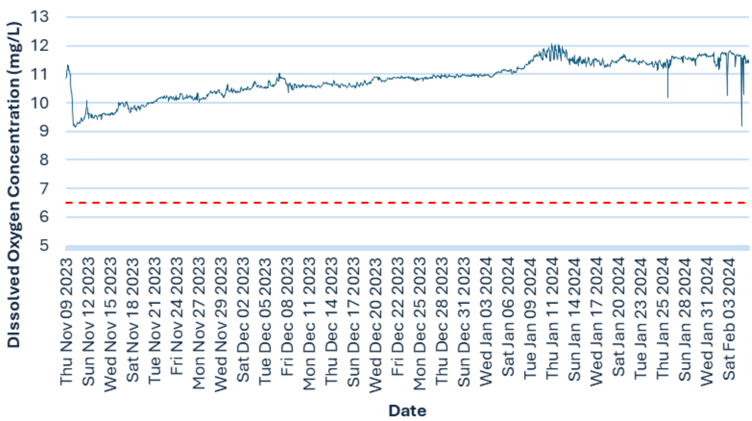

Figure 16: Dissolved Oxygen Concentration values (Milligram per litre) recorded by the WATR monitoring buoy from November 2023 - February 2024. (Red dashed line indicates minimum threshold for a healthy temperate marine ecosystem - 6.5mg/l.)

Analysis of historical datasets

Data sets were sourced from the Environment Agency (dissolved oxygen, nitrates and phosphates, bathing water quality status) and the River's Trust (sewage discharges from Combined Sewage Overflows CSOs)

For the most part the Environment Agency's dissolved oxygen measurements from St Austell Bay stay within the range expected for a cool temperate system (8-10 mg/L), however as can be seen in figure 17, the measurements have dipped below this range more frequently in the last decade and have occasionally dropped into oxygen deficiency (below 6.5 mg/L).

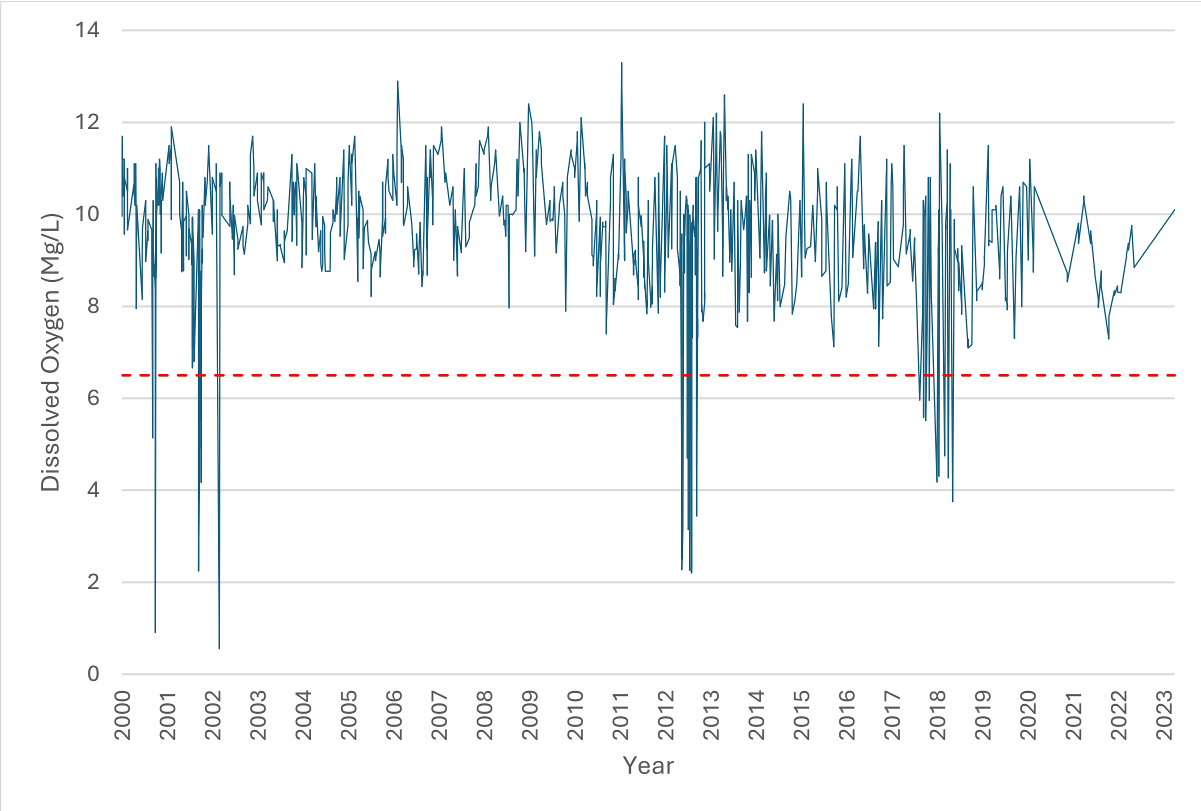

Figure 17: Dissolved oxygen concentrations (mg/l) in St Austell Bay (2000-2023). Data source: Environment Agency (Red dashed line indicates minimum threshold for a healthy temperate marine ecosystem - 6.5mg/l.)

Promisingly, nitrate levels have declined within St Austell Bay between 2012 and 2022 (see figure 18) and mean nitrate values across the study area in 2022 were 1.55 ± 2.39 mg/L (well below the government general quality assessment value which is 30 mg/L). However, phosphate measurements, which are only available for four years (2002, 2003, 2012, 2017), exceeded the recommended threshold set by government agencies of 0.1mg/L in those taken most recently (see table 1)

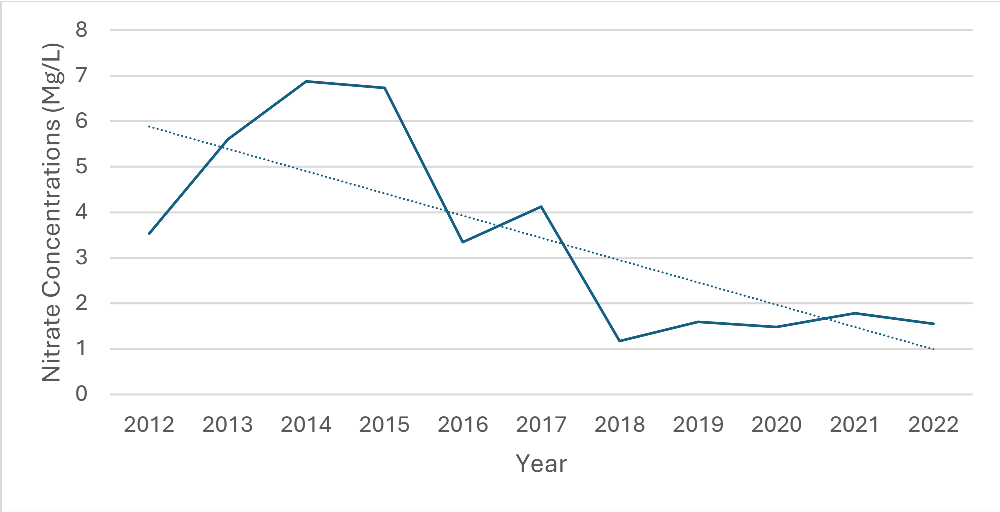

Figure 18 Nitrate concentration in St Austell bay (source Environment Agency).

Table 1: Mean (±SD) values for Phosphate concentrations (mg/L) within St Austell Bay for all available years to present (2002 - 2017), n = total number of observations (source Environment Agency).

Year	n	Mean	±SD
2002	1	0.1	
2003	3	2.857	3.827
2012	45	0.161	0.172
2017	2	0.362	0.113

Assessment of combined sewage outflow (CSO) data derived from The Rivers Trust indicated that though sewage incidences and duration remain high and frequent (74 spill events in 2022), they have been declining since 2020 with a 24% decline in the number of incidences comparatively from 2020 to 2022.

Designated bathing waters in England are classified on a scale from Poor to Excellent based on annual assessments of *Escherichia coli* (EC) and intestinal *enterococci* (IE) concentrations. Three out of the four sites assessed had consistent bathing scores of excellent (2021-2023), including Pentewan, (despite combined sewage overflow data suggesting it has received the highest number of spills). Par Sands is the only site of the four assessed to not have 'excellent' status (see table 2)

Table 2: Bathing water profiles for four beaches in St Austell (Porthpean, Duporth, Par Sands, and Pentewan) (DEFRA, 2024).

	Porthpean		Duporth		Par Sands		Pentewan	
	EC	IE	EC	IE	EC	IE	EC	IE
2023	Excellent	Excellent	Excellent	Excellent	Sufficient	Sufficient	Excellent	Excellent
2022	Excellent	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent
2021	Excellent	Excellent	Excellent	Excellent	Sufficient	sufficient	Excellent	Excellent

St Austell Bay Seagrass Analysis 2023

Morphological and nutrient analysis of subtidal seagrass (*Zostera marina*) was conducted by University of Exeter MSc student Eva Christofferson (2024) over the summer of 2023 at four sites within St Austell Bay: Carlyon, Duporth, Polkerris, and Porthpean. Between 4-6 photos of quadrats were taken each time to establish seagrass cover (see figure 19). To measure shoot length and epiphyte cover, five random shoots were selected and cut from each site once a month. Once back in the lab, the epiphytic growth cover on the plants was estimated and the length and width of the blades measured. Samples from the newest blade were taken to measure nitrogen and carbon content. (Analysis of this can give an indication of how much nitrate has been available to the seagrass, and also how much light it has received.) These samples were compared to historical data collected previously by the University of Exeter from other sites around Cornwall and the Isles of Scilly for comparison.

The seagrass meadow at Polkerris was taller and denser than the other locations in St Austell Bay, although all sites were shorter than seagrass measured at other locations around Cornwall. The epiphyte cover was generally denser at Porthpean and Duporth, and nearly non-existent at Polkerris. The sparsest seagrass was at Carlyon.

Overall, both morphological and nutrient analysis indicate seagrass within the area is considered to be healthy, with low epiphytic cover and no indications of limited growth in leaf length. This is supported by the percentage of elemental nitrogen and carbon which were in line with global averages. Carbon: Nitrogen ratios across sites showed variability throughout the sampling period with values below the critical value, thereby suggesting light limitation. Repeated analysis over multiple summer seasons would be beneficial to support this conclusion, alongside the analysis of elemental phosphorus and a more detailed look at turbidity values to identify if sources of effluent are an influencing factor in seagrass light attenuation.

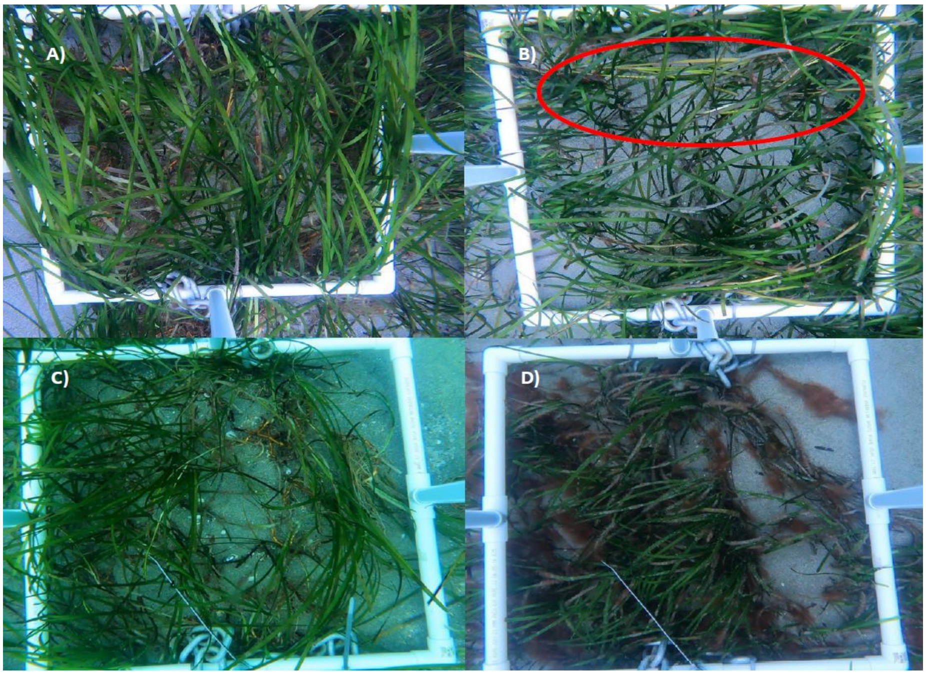

Figure 19 A) Seagrass meadow at Polkerris, with high shoot coverage and free roots. B) Seagrass at Polkerris showing flowering shoots highlighted in red circle. C) Seagrass at Carlyon showing uprooting. D) Picture of seagrass at Duporth with the highest epiphyte cover, seaweed and rotting seagrass recorded in area. Christofferson (2023)

Overall Water Quality Conclusions

Some of the water quality indicators are positive but there are areas of concern especially with regards dips in oxygen levels, high phosphate readings and frequent sewage discharges.

The steady and consistent dissolved oxygen levels from the Watr Buoy pilot data, in addition to the long-term Environment Agency data set, show that most of the time oxygen and temperature are within healthy limits. However, there are points where dissolved oxygen has dropped below the minimum safe threshold (more frequently in recent years) so this continues to be a vital aspect to monitor.

The variability in the turbidity readings from the Watr buoy demonstrated work is required to better understand the influence of the maintenance needs of the device on the reliability of results. This is of particular importance as the public access datasets for this area for turbidity are measured in differing ways, making comparative analysis challenging

The short-term period of data collection for the real-time analysis was limited to three months therefore the conclusions drawn at this early stage are limited and continued use of real-time monitoring devices across the St Austell Bay area is strongly recommended to provide robust, reliable datasets suitable for analysis.

Seagrass monitoring adds an interesting angle to the other indicators. Whilst the measurements indicate the seagrass is generally healthy, it is shorter and sparser than at other sites around Cornwall. More work needs to investigate if this is due to factors such as wave exposure or nutrient stress and less light availability due to turbidity.

Summary

The acoustic survey maps reveal an extensive mosaic of invaluable blue carbon habitat with nearly 800 hectares of maerl. Although the total cover of maerl in this area is at least 20%, the larger proportion (84%) of this has a low (<5%) percentage of living maerl compared to other sites further down the coast and particularly compared to the more protected waters of the Falmouth and Helford SAC. Together with the eDNA and water quality results, this research reveals the extent of this precious, irreplaceable habitat and indicates that it is potentially under stress and needs urgent monitoring and protection from impacts in order to recover.

Dive studies and eDNA illustrate the diversity of life supported by the habitats within the bay. The pilot eDNA study identified 33 fish species using the bay, including notable commercially important species which highlights the economic importance of the bay for commercial fisheries. The dive studies reflected a broader picture of diversity across all taxa, with Seaseach surveys finding 96 species and Natural England divers finding on average 61 species per quadrat. Even though maerl dive sites in St Austell Bay had a relatively low percentage cover of live maerl (on average) and showed similar ecological functioning to other sites surveyed further down the coast in areas of denser live maerl (ie in terms of number of species found and the community composition). This reiterates what has been reported in research elsewhere, that even maerl with a low percentage of living cover is vitally important habitat for other species and can support a diverse ecosystem.

Water quality is a mixed picture, whilst most indicators are within accepted limits and nitrate levels have promisingly declined, there is evidence that this is something that needs further monitoring and a more comprehensive understanding. There are gaps in historic data and we know there are still frequent releases from combined sewage outfalls. There is little data on other important nutrients, especially phosphates. Molecular studies on the seagrass indicate periods of nutrient stress and increased turbidity. Historical data shows periods of dissolved oxygen below the threshold for ecosystem health. Further monitoring and analyses are required to better understand the impacts of water quality on these habitats as well as their sources, to inform and direct any future conservation action.

Recommendations:

Continue to map and research seabed habitats along the extent of the SPA as most of this has not been mapped recently, if at all. An accurate understanding of the full extent and connectivity between the seagrass, maerl, kelp and other important habitat is vital to inform management and conservation. Extent of important habitats beyond the SPA designation should also be investigated.

Research into ecological linkages between dependent wildlife and seabed integrity. This will increase understanding of the ecosystem and can be used to advocate for a whole site management approach to the SPA. Use of dive surveys and eDNA have proven useful complementary methods and should be continued alongside other survey techniques such as BRUVs.

Investigate the benefits that seabed habitats provide for the fishing community, plus the impacts associated with these industries and activities on the subtidal environment and habitats. This can inform options for cost-effective methods to manage these pressures for the protection of seagrass and maerl, as well as to ensure a sustainable fishery.

As poor water quality can affect marine habitats and wildlife as well as affect human health, it is vitally important that nutrients, turbidity and dissolved oxygen, along with other indicators, continue to be monitored and the sources of pollution identified. Use of more real time water monitoring systems with publicly accessible data streams could allow spatial and temporal identification of pollution events and provide insight into sources of water pollution. A critical indicator of ecosystem health and water quality, dissolved oxygen should be monitored at depth as well as near surface. The impacts on water quality of maerl and seagrass specifically requires further investigation through tissue analyses.

There continues to be frequent releases of raw sewage from Combined Sewage Overflows which needs continued monitoring to enable action to be appropriately targeted. There needs to be continued pressure on South West Water to reduce these.

The water quality investigation also highlighted gaps in data on important pollutants, such as phosphates, which need further specific investigation. Other ‘forever’ pollutants such as PAHs (including chemicals used as flame retardants and pesticides), pharmaceuticals and illegal narcotics should also be investigated where possible.

Maintain and develop cross collaboration and data sharing. Sharing information and research efforts between interested parties (ideally with the aim of having data open and available) into seabed habitats and marine life will increase information. reduce duplication of effort and create more effective conservation and management.

Continue to ensure that all data produced as a result of this project and subsequent projects is made publicly available to improve its accessibility and ensure it can be used to inform conservation action and management. We recommend that this should be via the national MAGIC mapping portal and at a local level, the Cornwall Marine Data Portal.

The blue carbon potential of these habitats should be accurately addressed along with their biodiversity importance and other ecosystem services, to ensure their value is fully recognised in management, planning and development.

A cross-party horizon scanning exercise should be undertaken to identify any potential new developments or pollutants incidents that could affect the coastal habitats of St Austell bay (and the Cornish coast at large).

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Appendices

Appendix A: Explanation of water quality indicators

Dissolved oxygen

Oxygen is used by nearly all living things and so is a critical measure of water quality. Increased microbial activity (in turn due to increased organic matter or nutrients) and increased temperature can both result in decreased dissolved oxygen, thereby reducing the capacity of the water column to support life. Sea areas of little or no oxygen, so called 'dead zones', are a growing problem for the world's coastal seas, scientists estimate these have quadrupled in the last 50 years. Nutrient pollution and global warming are key contributors to this.

A minimum dissolved oxygen value of 6mg/l is expected within temperate marine ecosystems, however considering it is a temperate region where average water temperatures are cool, an appropriate optimum threshold for a marine ecosystem within this region should be expected to be approximately between 8-12mg/l, equating to dissolved oxygen saturation levels of approximately 80-110%.

Temperature and salinity

Both temperature and salinity affect the amount of oxygen in water. There is an inverse relationship between dissolved oxygen and temperature; as temperature increases in water, dissolved oxygen decreases (figure 5) and in addition, increased temperature increases the oxygen demand of most marine organisms. Salinity also interacts with dissolved oxygen, with dissolved oxygen decreasing as salinity increases.

Nutrients

Whilst nutrients are necessary for healthy marine ecosystems, increased nutrient loading, most commonly from the major nutrients of Nitrogen (N) and phosphorus (P), can impact the structure and function of coastal ecosystems. Nutrient overloading (eutrophication) leads to increased algal growth; this can reduce coastal health in many ways. For instance, it can lead to blooms in phytoplankton and the subsequent death and decomposition of these lead to de-oxygenation of the water column, it also increases the likelihood of toxic algal blooms. In addition, sensitive photosynthesising benthic habitats such as seagrass, maerl and kelp can be affected as blooms or overgrowth by opportunistic attaching algae block light and reduce their ability to photosynthesise.

Turbidity

Turbidity is the cloudiness of a liquid caused by particles. Increased turbidity can be due to sediment mixing from wave action, blooms of plankton, or run-off from streams and outfalls. In addition, activities such as anchoring, trawling, or dredging can also increase sediment suspension in the water column and so increase turbidity. Particles and plankton are a natural part of coastal ecosystems, but high turbidity can detract from water quality in a number of ways: releasing nutrients, blocking light though the water column and, in extremes, affecting gills and filter feeding structures of animals.