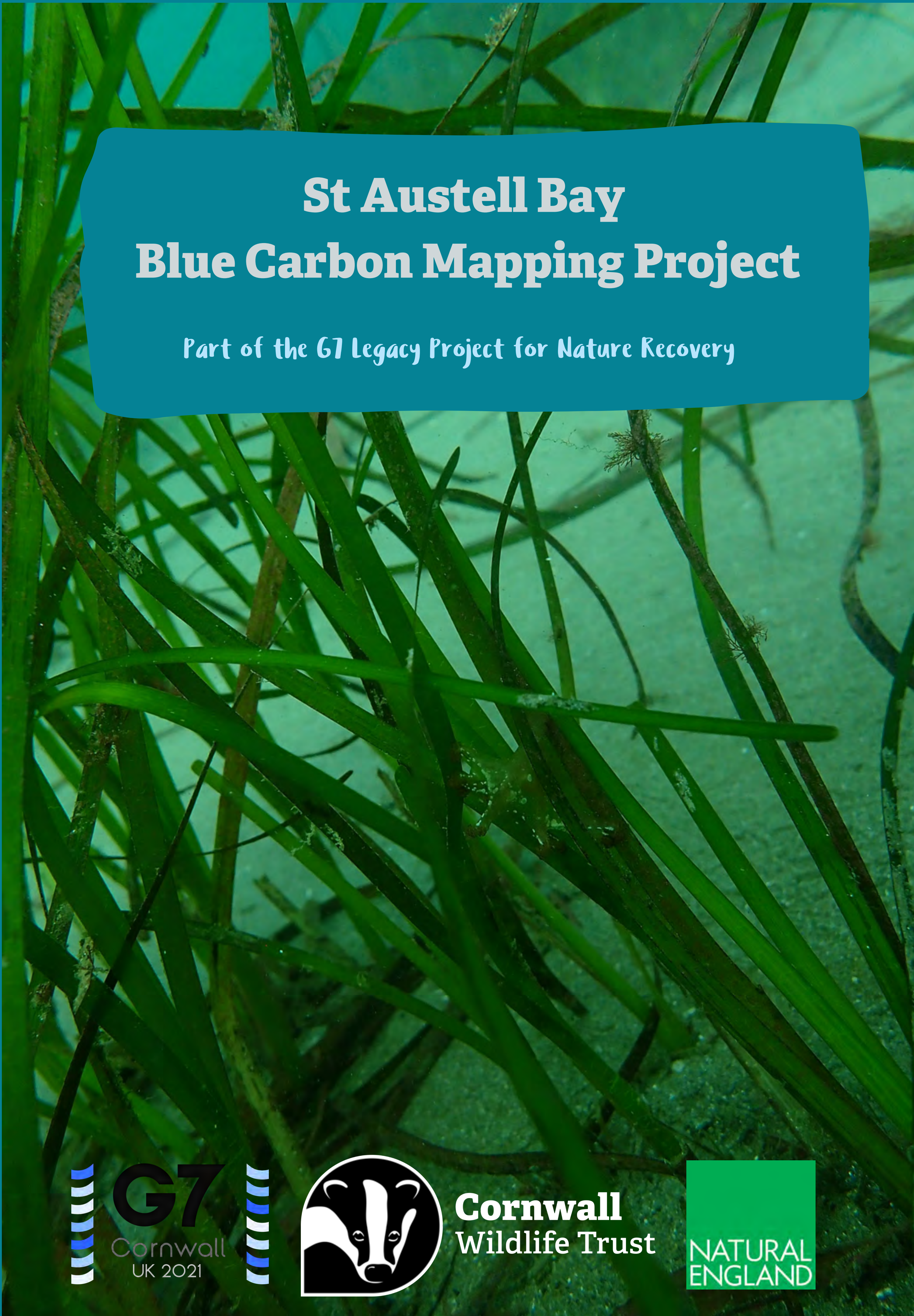

St Austell Bay Blue Carbon Mapping Project

Part of the G7 Legacy Project for Nature Recovery

G7 Cornwall UK 2021

Cornwall Wildlife Trust

NATURAL ENGLAND

CONTENTS

EXECUTIVE SUMMARY

The G7 Legacy Project for Nature Recovery (G7 LPNR) is an ambitious land and sea nature recovery project looking to deliver a legacy for wildlife, climate, and people in Mid-Cornwall.

To target marine nature recovery programmes in this catchment, it is essential to understand the status of an area of sea and particularly its biological components (Marine Nature Recovery (MNR) report, June 2021). Currently, the baseline evidence (ecological or activity-focused) to support strategic planning around marine nature recovery action for St Austell Bay, part of the G7 LPNR catchment, is incomplete and widely dispersed.

The St Austell Bay Blue Carbon Mapping Project, coordinated by Cornwall Wildlife Trust, aimed to remedy this by undertaking baseline studies and surveys through a combination of:

- mapping of 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 in partnership with Cornwall Inshore Fisheries and Conservation Authority (IFCA),
- and dive surveys via Cornwall Wildlife Trust's Seasearch programme for condition assessment and ground truthing.

As a result of the acoustic surveys conducted by Cornwall IFCA, it has been found that St Austell Bay is supporting Cornwall's largest known seagrass bed at 359.1 hectares (887 acres). The area of seagrass within St Austell Bay also makes it one of the largest known beds within the UK.

The historic datasets show that St Austell Bay, Veryan Bay and Gerrans Bay also support significant areas of maerl. However, due to limited project resources, these maerl beds were not re-surveyed using acoustic survey techniques since 2016.

The Seasearch data shows that a total of 66 species were recorded within the maerl dive sites, and a further 56 species within the seagrass dive sites, proving the high biodiversity value of these habitats. Several rare and significant species were discovered during the dive surveys including the short-snouted seahorse Hippocampus hippocampus (a Biodiversity Action Plan species), and the commercially important scallop species Pecten maximus.

The St Austell Bay Blue Carbon Mapping Project has provided a significant first step towards understanding the extent and quality of blue carbon habitats in the St Austell Bay area. On reviewing the project and its outputs, and seeking input from our project partners, a list of recommendations have been included to inform next steps and further research priorities for blue carbon habitats in the St Austell Bay and surrounding catchment.

INTRODUCTION

1.1 G7 Legacy Project for Nature Recovery

The G7 Legacy Project for Nature Recovery (G7 LPNR), which was announced by the Prime Minister 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.

Cornwall Wildlife Trust and Natural England facilitate 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:

1. Create new nature rich land and sea, as well as connecting and restoring sites, species, and landscapes.
2. Capture approximately 440,000 tonnes of carbon dioxide through its work.
3. Improve access to green and blue spaces to engage and empower local communities to work with nature for health, wellbeing, and future resilience.
4. 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.

During its first year (2021 – 2022) G7 LPNR funded 26 projects, with a further 10 projects in year 2 (2022 – 2023), all of which contribute to the overall objectives. These projects include social prescribing, marine bycatch reduction research, improved access to nature for communities, habitat restoration, no fence livestock trials, and marine mapping.

The G7 project is now aligned with 5 other national landscape-scale nature recovery projects set up by Natural England to drive nature recovery as part of its Nature Recovery Strategy across the UK.

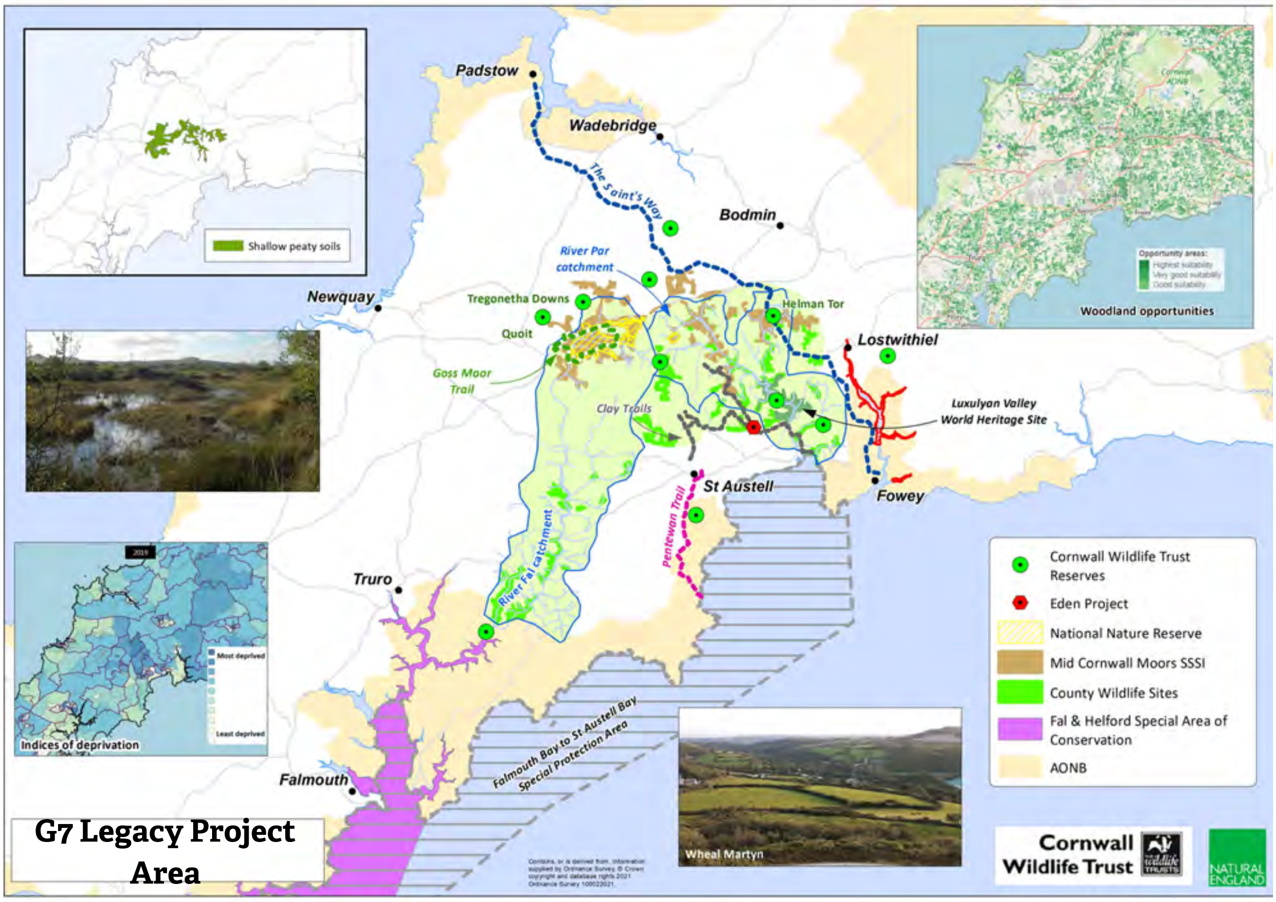

Figure 1: G7 Legacy Project for Nature Recovery Project area map

1.2 Nature Recovery At Sea

As stated in the June 2021 Marine Nature Recovery (MNR) report by Cornwall Council, Cornwall Wildlife Trust, and Natural England, marine nature recovery is:

'needed to reverse past declines in wildlife and habitats and bring our seas back to life, so that they are healthy and thriving now and into the future for people, climate, and nature.'

The report goes on to highlight that marine nature recovery is not just about biodiversity, however, but also improving ecosystem resilience to climate change and providing natural solutions that reduce carbon emissions. It is therefore important to look beyond biodiversity and recognise the extent of 'blue carbon' habitats that exist around our coastline and take action to protect them against damaging activities.

To enable us to undertake these actions, the June 2021 MNR report identified that it was essential to have access to relevant evidence to understand the extent and quality of key habitats and species. Currently the baseline evidence (ecological or activity-focused) to support strategic planning around marine nature recovery action is incomplete and widely dispersed. Rectifying this will be an important first step towards identifying opportunities and planning allocation of resources.

Regarding blue carbon, assessing the extent and quality of these vital habitats is not currently holistically reported on in Cornish waters. Steps need to be taken to improve and collate all monitoring, whether routine (via statutory bodies IFCA, EA and NE) or otherwise (universities, NGO projects) which could effectively contribute to a blue carbon indicator.

It was also stated as a recommendation in the June 2021 MNR report that marine nature recovery must be integrated into action on terrestrial nature recovery rather than developed in isolation. Cornwall Council have made a positive start to this by including coastal and marine nature recovery elements into their draft Local Nature Recovery Plan. It is also a positive development to have marine nature recovery projects included in the G7 LPNR project to better enable this holistic approach.

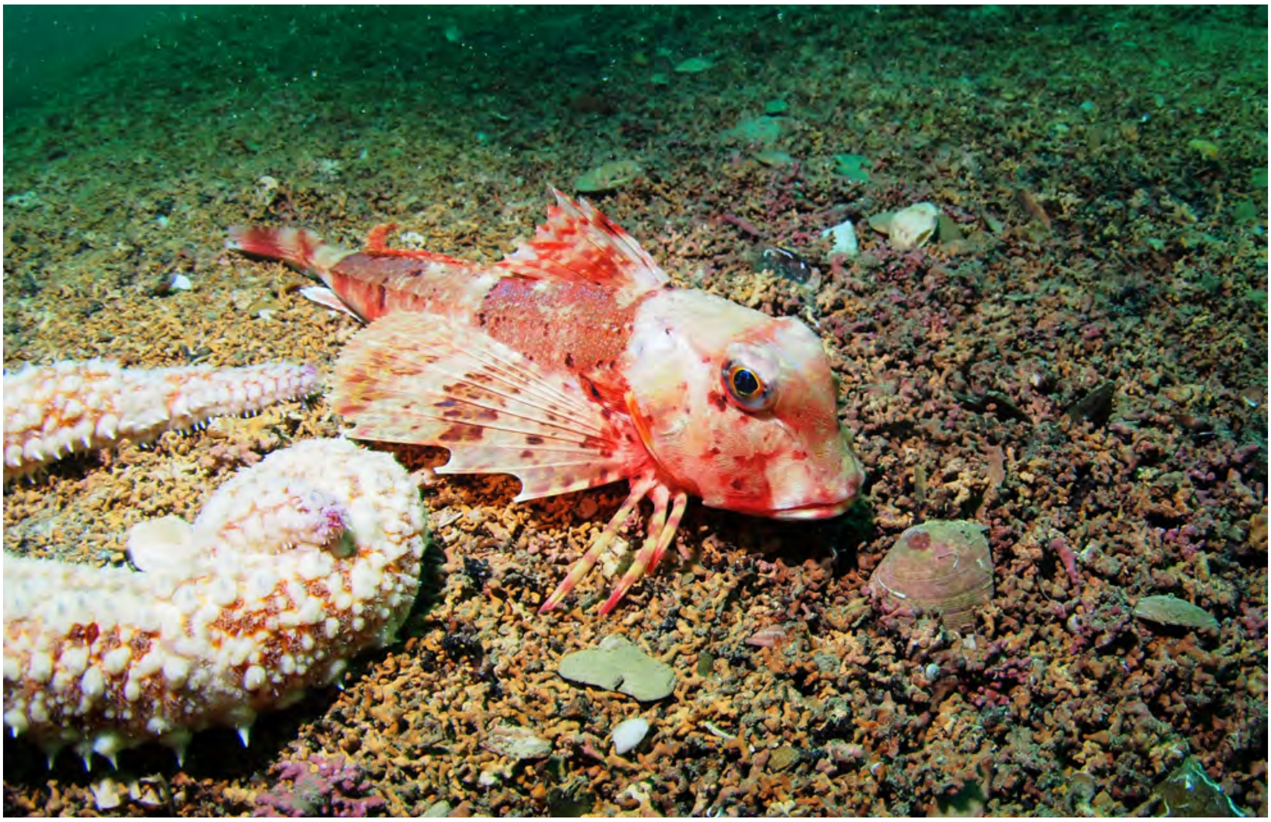

Photo 1: Streaked gurnard on maerl, an important blue carbon habitat, in St Austell Bay, photo by Matt Slater

1.3 Marine Environment of St Austell Bay and Surrounds

St Austell Bay, located on the south coast of Cornwall and within the G7 LPNR project catchment, is a relatively sheltered inshore environment. It supports an array of coastal and marine habitats including sand dune systems, sandy beaches, intertidal rocky shore, and subtidal sands, sediments, and rocky reef. It also supports significant areas of the blue carbon habitats of seagrass and maerl; biodiversity hotspots which effectively store and absorb large quantities of carbon, acting as a nature-based solution to climate change.

In addition to their role in sequestering carbon and supporting biodiversity, blue carbon habitats provide vital services supporting coastal protection, water quality, and food provision.

Maerl is a very 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. The living maerl sits on top of layers of dead maerl which builds up over time (centuries or millennia) to form the bed. Several species of free-living coralline algae (otherwise known as rhodoliths) can form maerl beds. In Cornwall, there are currently two known species – Phymatolithon calcareum and Lithothamnion corallioides – which form beds in areas along the south coast of the county, particularly within the Fal and Helford Estuary and, as discovered in the last decade, St Austell Bay. Due to its biodiversity importance and rarity in the UK, maerl beds are a Biodiversity Action Plan (BAP) habitat and both maerl species are BAP species. Research has also found that maerl beds can store large quantities of blue carbon (Mao, 2020) 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.

Seagrasses are the only true flowering plant that grows in our seas. The meadows are important because they stabilize the sediments in which they grow and provide food and shelter for other species thereby enhancing biodiversity. The leaves provide shelter from predators and can be colonised by algae and a wide range of invertebrates. These in turn act as a food source for various fish species. In addition, seagrass beds provide good nursery areas for many fish species, helping to sustain fish stocks for our local fishing industry. Seagrass sequesters and stores carbon in its above ground (the plant itself, leaves and branches) and below ground biomass (the root and rhizome systems), as well as in the sediment below and around them. When seagrass meadows are stable and healthy, they can be highly productive carbon sinks, in some cases storing more carbon per unit area than terrestrial forests.

St Austell Bay benefits from one formal marine conservation designation, the Falmouth Bay to St Austell Bay Special Protection Area (SPA). This was designated in 2017 and covers an area of 258,98 hectares which includes a large marine area as well as shallow sandy bays, an estuarine area, and part of a tidal river. The qualifying interests for the site include wintering populations for black-throated diver, great northern diver and Slavonian grebe. (Natural England Research Report, September 2022)

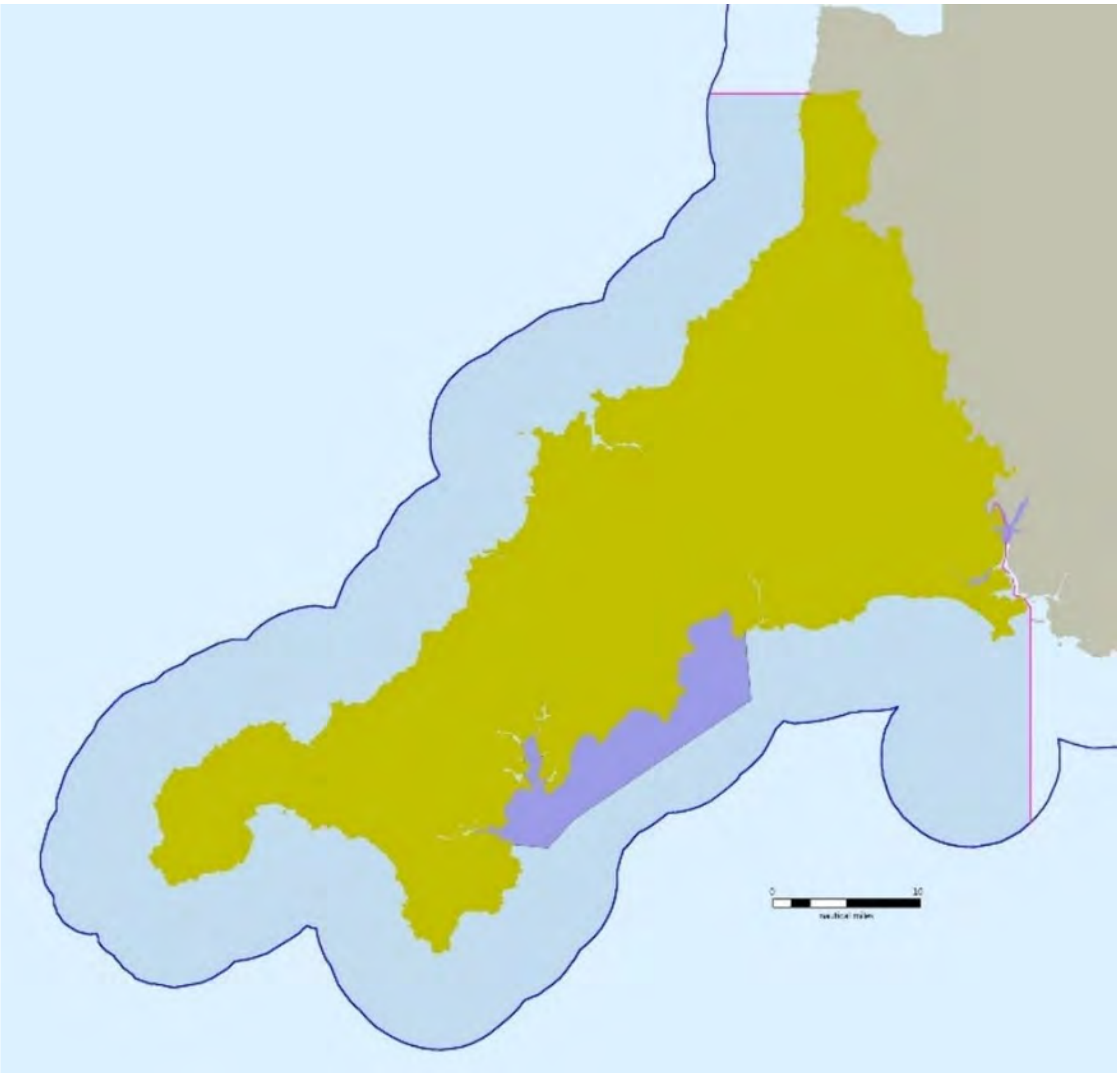

Figure 2: Falmouth Bay to St Austell Bay Special Protection Area (SPA) https://www.cornwall-ifca.gov.uk/marine-protected-areas

Photo 2: Great northern diver, cited species within the Falmouth to St Austell Bay SPA, photo by The Wildlife Trust

1.4 St Austell Bay Blue Carbon Mapping Project

To target marine nature recovery programmes, it is essential to understand the status of an area of sea and particularly its biological components (Marine Nature Recovery (MNR) report, June 2021). Regarding St Austell Bay and the G7 LPNR catchment, we know that ecologically valuable blue carbon habitats such as seagrass, maerl and muddy sediments exist in the area, as described in section 1.3 of this report, but our knowledge of their true extent or condition has been limited due to current data provision. The St Austell Bay Blue Carbon Mapping Project aimed to remedy this by undertaking baseline studies and surveys through a combination of:

Mapping of 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

The project area focus was St Austell Bay, but due to the geography of the south coast and the awareness of the connectivity between St Austell and the Roseland peninsula, Gerrans Bay and Veryan Bay were also reviewed as part of this project.

This report presents the results from the three key project activities as listed above, plus a list of recommendations of next steps and further research to continue to improve our understanding of the quality and value of blue carbon habitats in St Austell Bay and its surrounds.

MAPPING HISTORIC DATASETS

In June 2022, Cornwall Wildlife Trust worked in partnership with The Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS) to collate and map existing data sets for the two identified key blue carbon habitats of seagrass and maerl in the bays of St Austell, Veryan and Gerrans.

No data for St Austell Bay was available on Magic Map Application at the time of carrying out this report (Magic, 2022).

The data were collated and mapped by the ERCCIS Data and Evidence Officer (Geographic Information). The maps created (Figures 3 to 5) demonstrate that there are considerable areas of seagrass and maerl in all three locations of Gerrans Bay, Veryan Bay and St Austell Bay. Environment Agency data (2019 and 2021) shows significant seagrass beds in both Gerrans Bay and St Austell Bay. Acoustic seagrass data, collected by the 2016 IFCA surveys, shows similar coverage but data seems to be limited by depth, likely due to the position of the sonar equipment on the hull of the vessel preventing shallow subtidal access. Data from Seasearch dive surveys are sparse across all three bays.

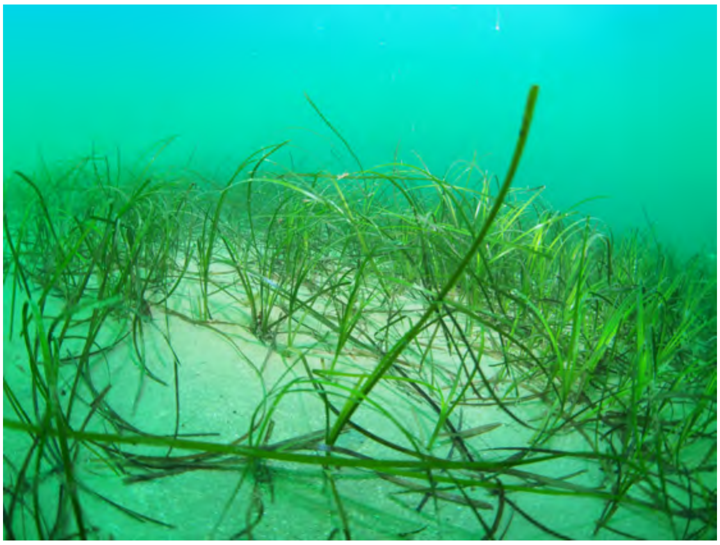

Photo 3: Seagrass in Carlyon Bay, within St Austell, photo by Matt Slater

Data was obtained from various sources including;

Environment Agency - Whitsand and Looe Bay, St Austell Bay and Fowey Subtidal Seagrass Surveys 2019, Joe Kenworthy , Estuarine and Coastal Monitoring and Assessment Service, Version 1.0, March 2020.

Seasearch (2004 - 2022). Seasearch Marine Surveys in England. Occurrence dataset https://doi.org/10.15468/kywx6m accessed on 23.08.2022. Marine Conservation Society.

Cornwall Inshore Fisheries and Conservation Authority (IFCA) - Veryan, Gerrans and St.Austell Bay Habitat classification from Side-scan Sonar Summary Report (20161108_CIFCA_pSPA_FBtoStA_SSSPOLY) , 08/11/2016 , Authors: Colin Trundle, Kimara Street, Annie Jenkin, Ryan Mathews and Hilary Naylor.

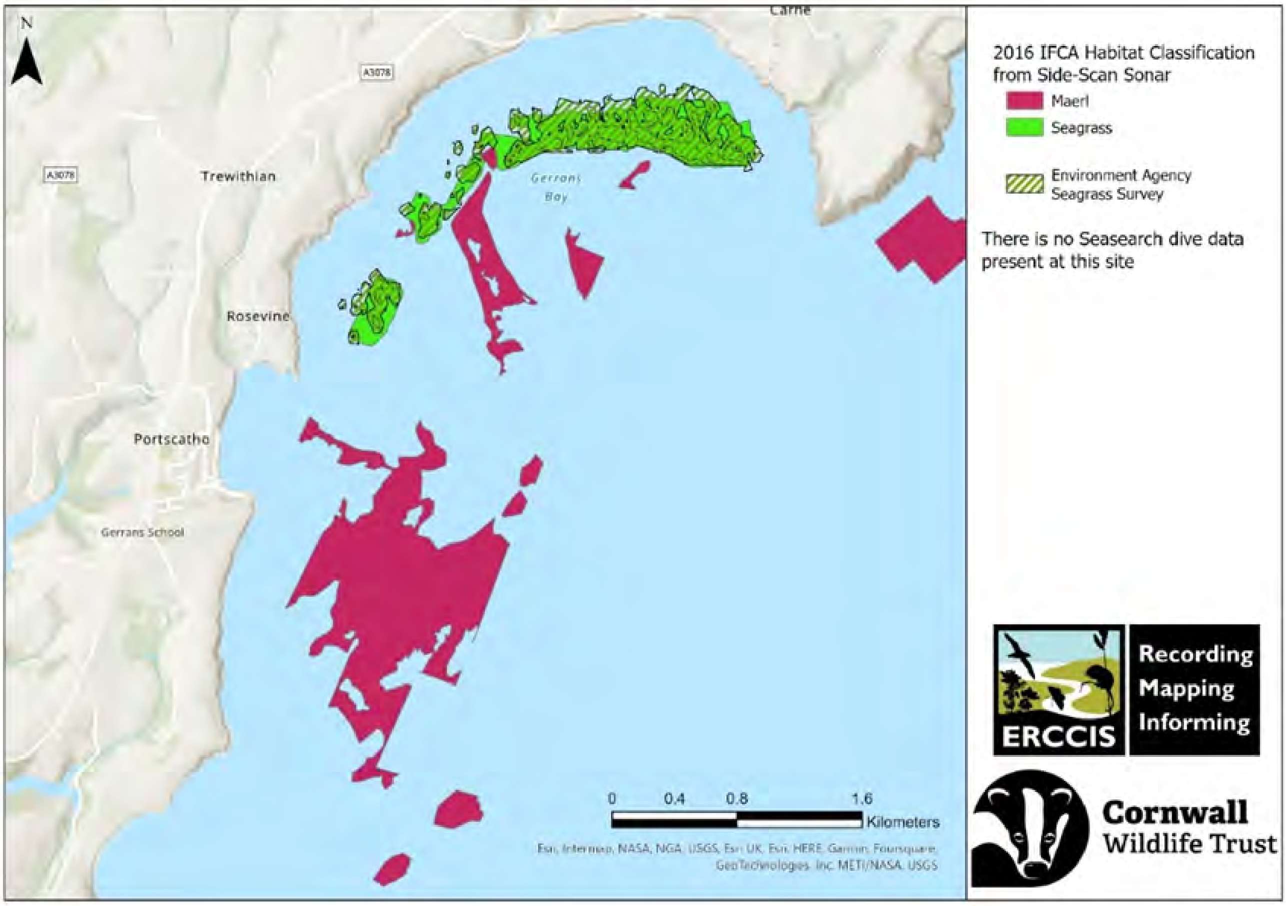

Figure 3: Historic data within Gerrans Bay

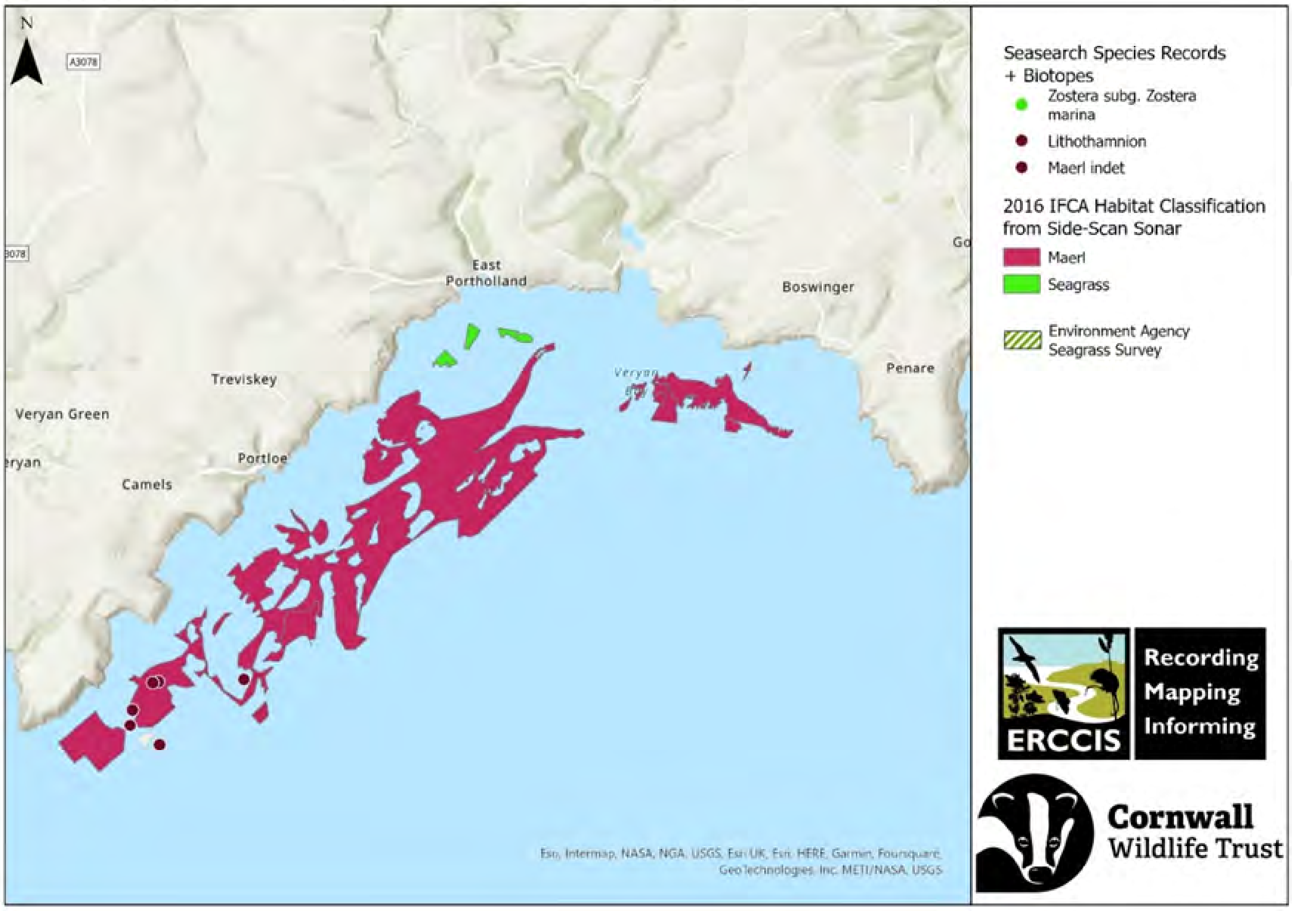

Figure 4: Historic data within Veryan Bay

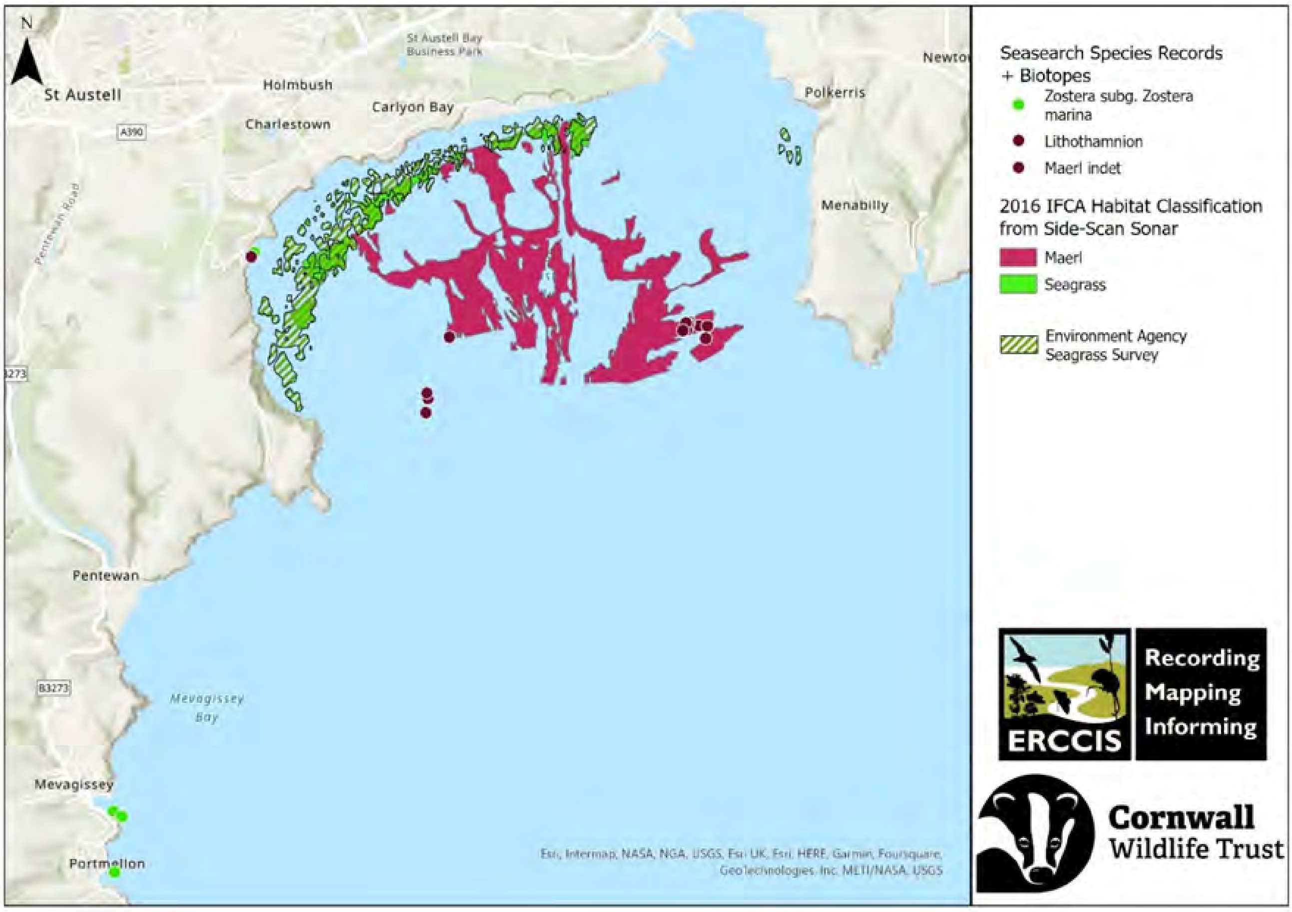

Figure 5: Historic data St Austell Bay

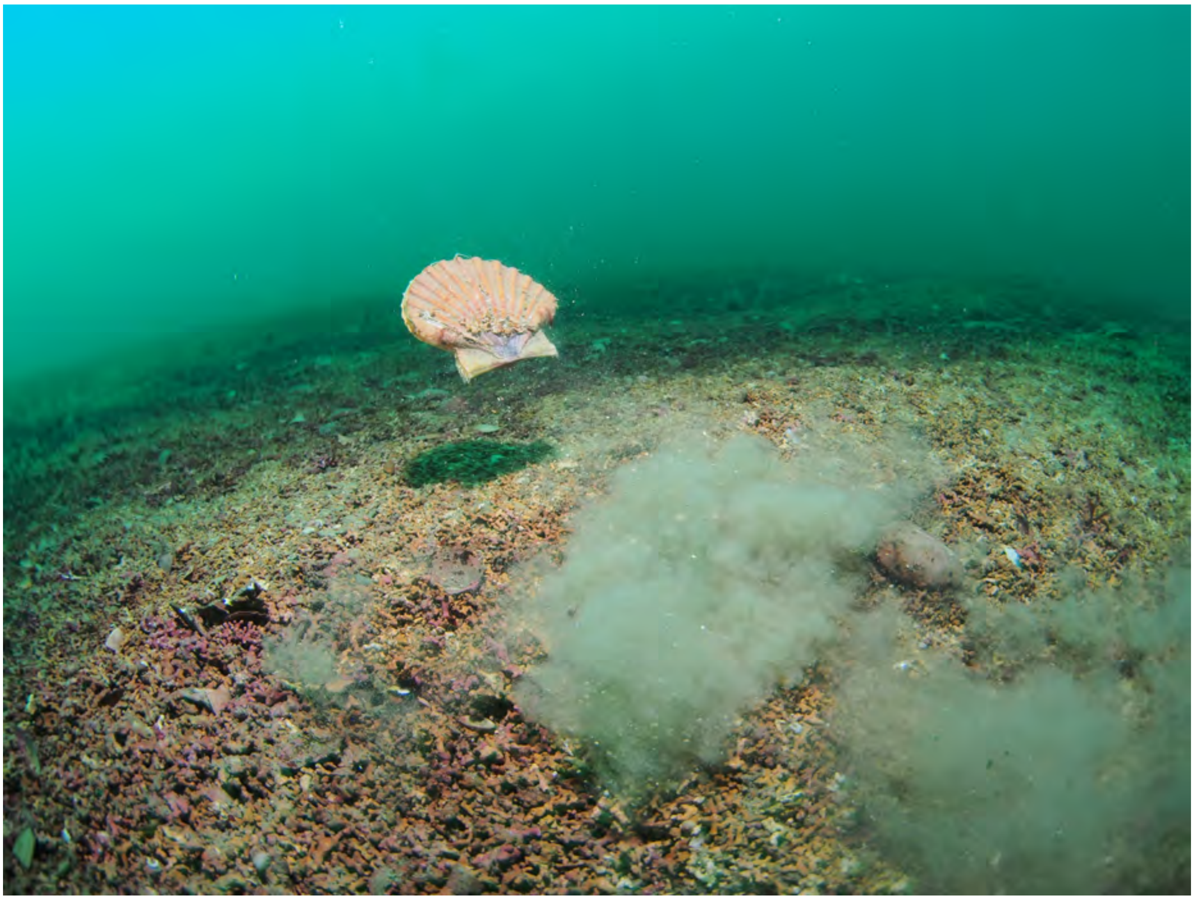

Photo 4: Scallop swimming over maerl habitat within St Austell Bay, photo by Matt Slater

BOAT SURVEYS

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA) was contracted by Cornwall Wildlife Trust to map the extent and coverage of the seagrass bed within St Austell Bay, Gerrans Bay and Veryan Bay using a Biosonics MX Scientific Echosounder.

The survey objectives were to:

- Complete acoustic surveys in Gerran's, Veryan and St Austell Bays using Bionsonics MX Scientific Echosounder in areas of known seagrass and beyond to assess any increases in extent.
- Verify the acoustic signal in areas where it is difficult to determine if seagrass is present.
- Use Biosonics Visual Aquatic software to analyse data.
- Use MapInfo Professional Advanced software to create contour plot outputs of plant height (cm) and plant coverage (%) where seagrass occurred at a coverage of >=5%

9 In total, IFCA completed 9 days at sea carrying out acoustic surveys using their Biosonics MX Aquatic Scientific Echosounder:

July 2022, Gerrans Bay
20th, 22nd, 27th and 28th

August 2022, St Austell Bay
4th, 8th ,16th, 18th and 25th

The acoustic data was captured using Biosonics' Visual Aquisition software which analyses the first and second echo values, logging data that provides estimates of seabed type along with the canopy height and density of any seagrass, or algae, identified.

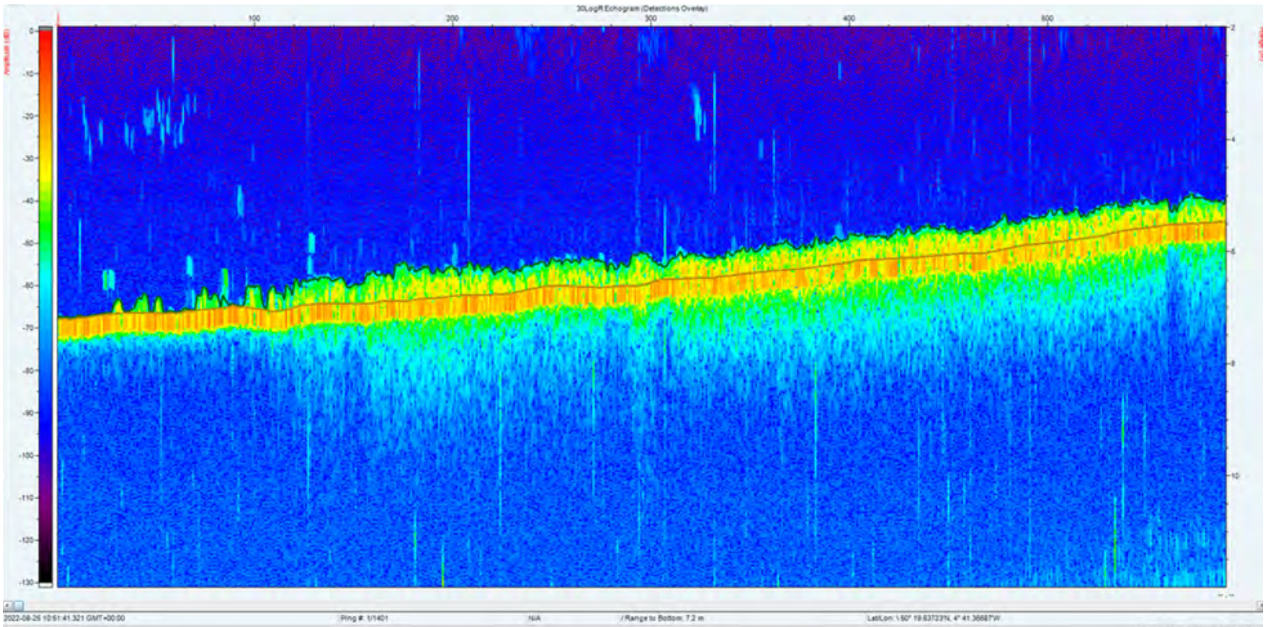

Figure 6: Bottom line (orange) and Plant line (green) as shown in the Visual Aquisition software in a dense seagrass bed (centre) and patchy seagrass (far left) within St Austell Bay.

The area (ha) of plant coverage >=5% to 100% was calculated by converting the raster from the percentage coverage using the polygonise tool in MapInfo Professional Advanced (Version 17.0.4) to draw a polygon displaying seagrass coverage from >=5 to 100%.

Please see Figures 7 to 10 below for the resulting contour plots of seagrass percentage cover and plant height (m) for Gerrans and St Austell Bay.

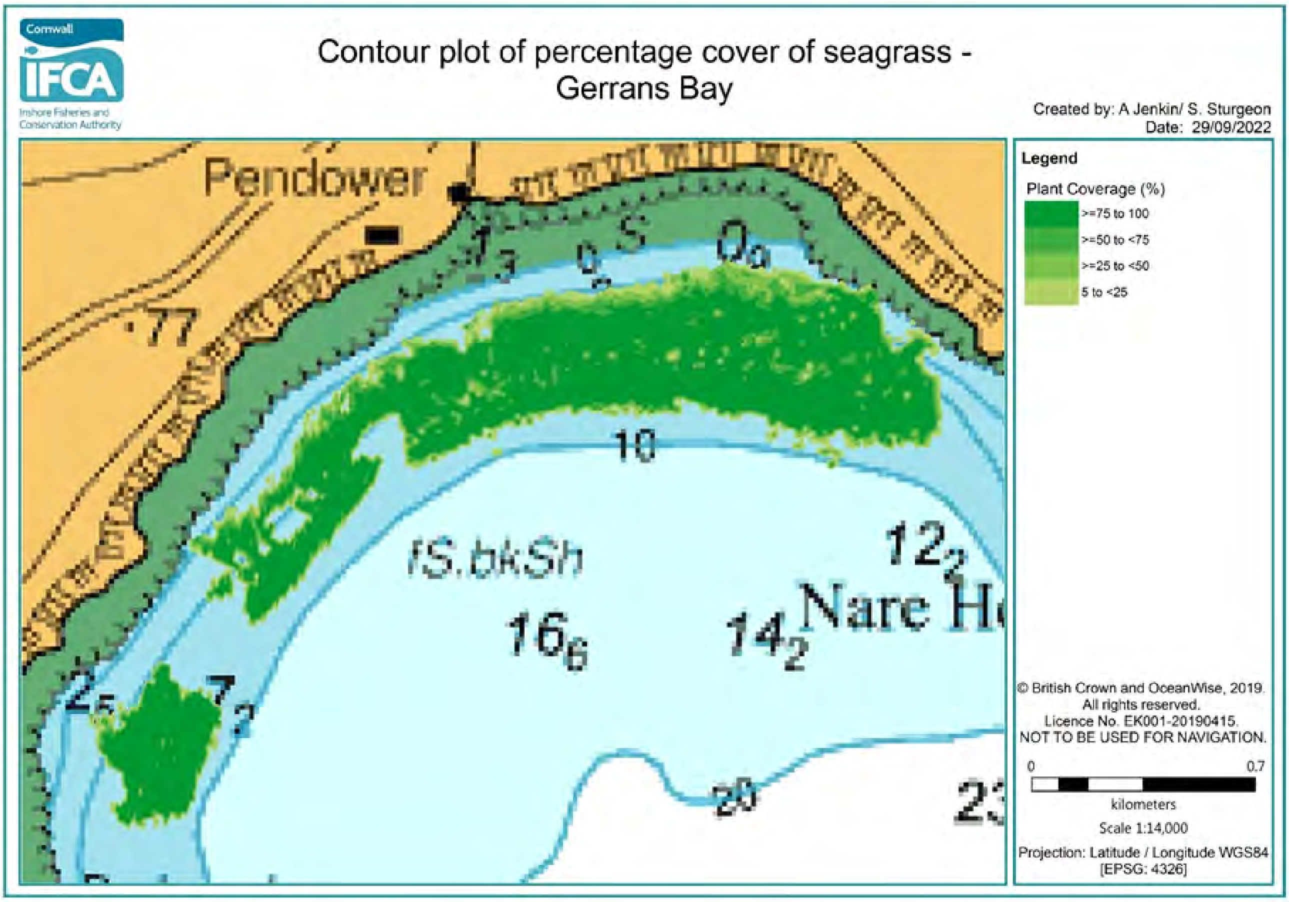

Figure 7: Contour plot of percentage cover of seagrass – Gerrans Bay (CIFCA 2022)

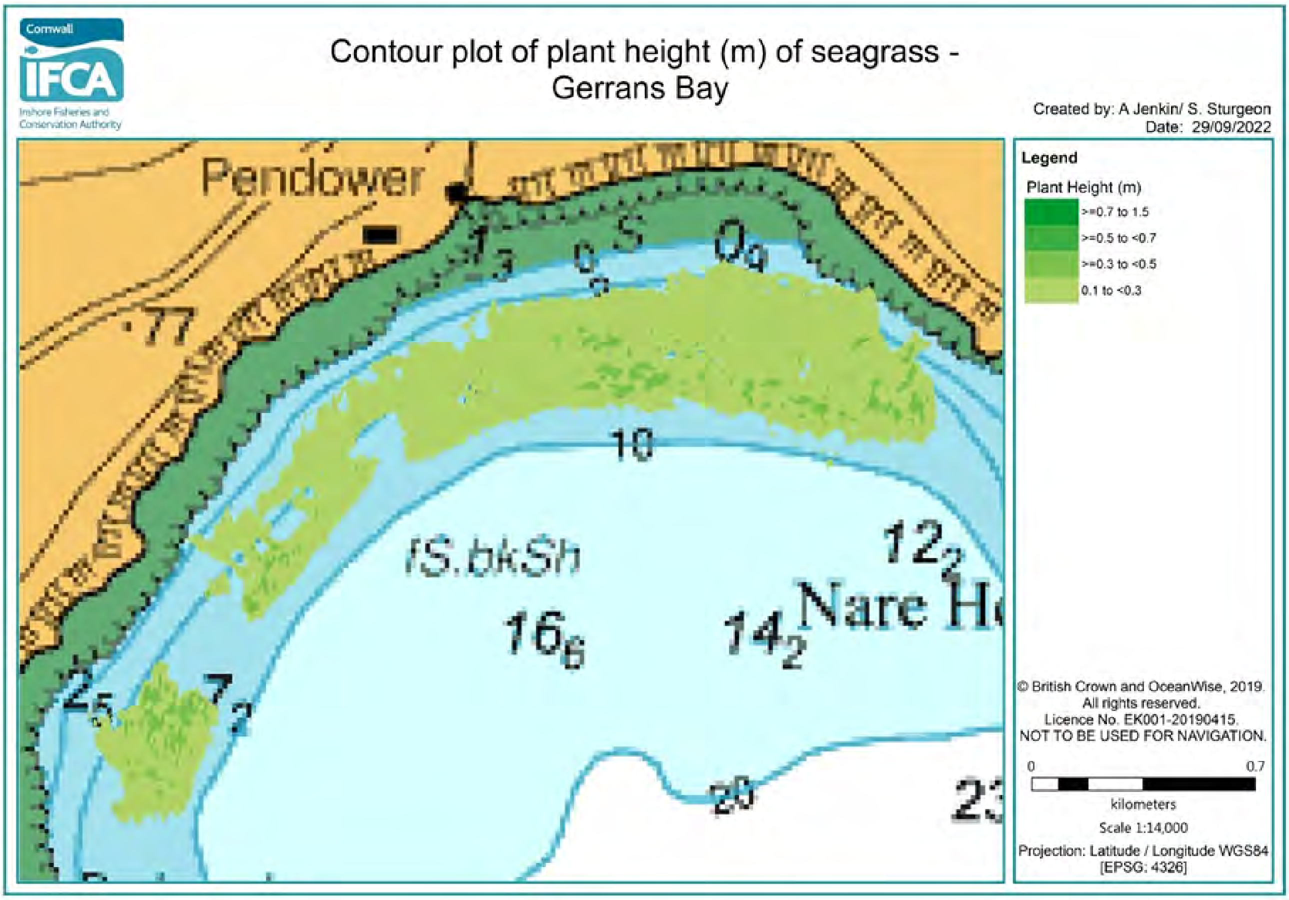

Figure 8: Contour plot of plant height (m) of seagrass – Gerrans Bay (CIFCA 2022)

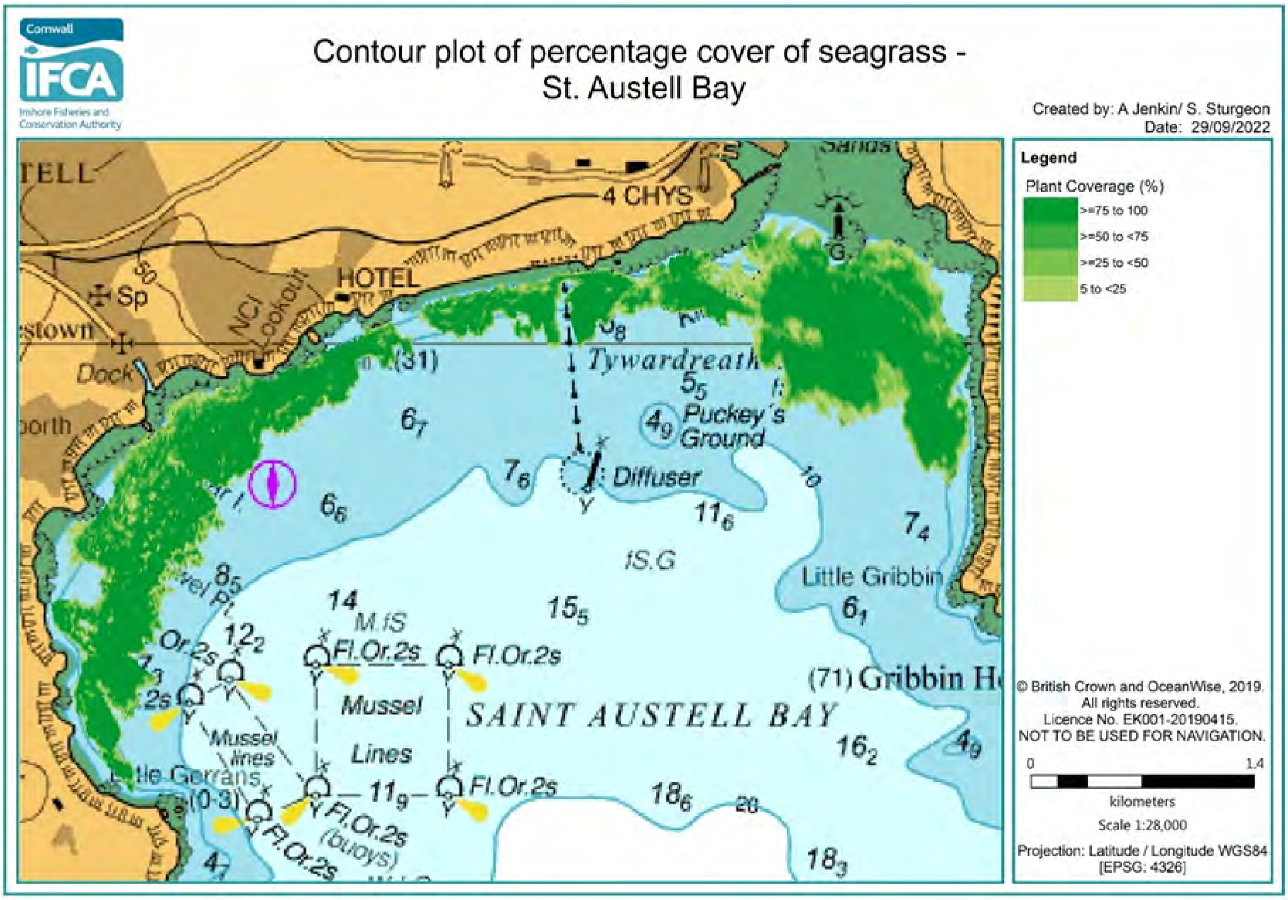

Figure 9: Contour plot of percentage cover of seagrass – St Austell Bay (CIFCA 2022)

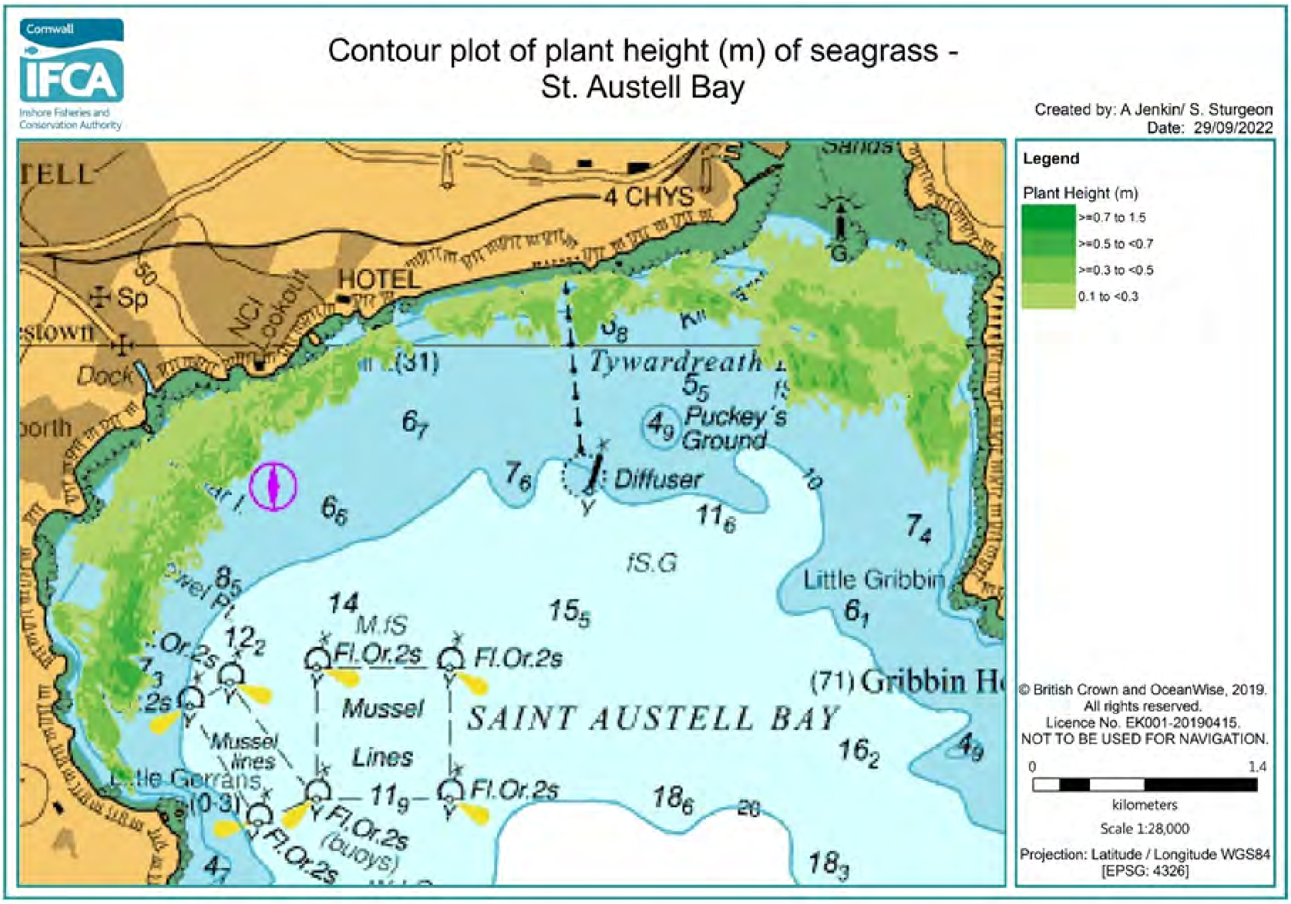

Figure 10 – Contour plot of plant height (m) of seagrass – St Austell Bay (CIFCA 2022)

The area (ha) of plant coverage >5% for Gerrans Bay and St Austell Bay seagrass beds is shown in the table below .

Seagrass Bed	Area (ha) of seagrass >=5% to 100% plant coverage
St Austell Bay	359.1
Gerrans Bay	103.8

Table 1: The area (ha) of plant coverage >5% for Gerrans Bay and St Austell Bay seagrass beds

As a result of these surveys, it is apparent that the seagrass beds in St Austell Bay are significantly larger than previous data suggested, both in its east and west reaches and also in depth profile. It has been confirmed that St Austell Bay alone supports 359.1 hectares of seagrass which makes it the largest seagrass bed in Cornwall from current knowledge (March 2023).

The acoustic surveys determined that the plant height of seagrass beds in St Austell Bay and Gerrans Bay is low with the majority of the plants within the beds being between 0.1 to <0.3m tall at the time of the surveys, (see Figures 8 and 10). The density of the beds was high, however, with both beds having a >75% to 100% coverage (Figures 7 and 9).

Due to limited time and financial resources within the project, and with additional limitations from poor weather and the unexpected extent of the seagrass in St Austell Bay which took more survey days than anticipated, Veryan Bay could not be acoustically surveyed during these investigations.

Field reports, which includes full methodology and results, have been completed for the acoustic surveys carried out and can be found in Appendix 1 and Appendix 2;

- Appendix 1: CIFCA_2022_St.AustellBay_MX_FieldReport_FINAL
- Appendix 2: CIFCA_2022_GerransBay_MX_FieldReport_FINAL

Data collated by this project and used in the Cornwall IFCA report is held by the Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS) and is available by request to the Wildlife Information Service at wis@cornwalwildlfietrust.org.uk subject to ERCCIS terms and conditions and data sharing agreements. For more information please see https://erccis.org.uk/ .

DIVE SURVEY

4.1 Overview of Dive Surveys

A series of Seasearch dive surveys were carried out by the Cornwall Wildlife Trust Seasearch dive team within St Austell Bay and Veryan Bay in September 2022 with the aim being to:

1. Look for the additional presence of blue carbon habitats, specifically maerl or seagrass.

2. Ground truth the findings of existing seabed mapping data and August 2022 data created by Cornwall Inshore Fisheries and Conservation Authority (IFCA).

3. Asses the condition, density, health, and associated biodiversity of these habitats.

Ten locations were identified as areas of interest within Gerrans Bay, Veryan Bay and St Austell Bay because of the historic data mapping exercise and the acoustic survey work carried out as part of this project. These were labelled as Sites 1 to 10 (see Figures 11, 12 and 13). None of the areas chosen had been previously investigated by Seasearch divers. Due to weather conditions preventing access to survey Gerrans Bay, an additional dive site was identified close to St Austell Bay where seagrass was hoped to be located (Site 11, Figure 15).

The divers involved in these surveys were all trained in recording marine habitats, both physical characteristics and biological communities using the Seasearch methodology. The results of the dives were collated via Seasearch Surveyor and Observation forms and will be available for reference via the National Biodiversity Network Atlas portal.

Photo 5; Seasearch diver Trudy Russell in action using a Seasearch dive slate to record marine habitats and species, photo by Cornwall Wildlife Trust

4.2 Seasearch Methodology

Seasearch is a national citizen science program established by the Marine Conservation Society in 1988. It is delivered throughout England, Wales, Scotland, Northern Ireland and Ireland by a network of skilled coordinators.

In Cornwall, Seasearch is coordinated by Cornwall Wildlife Trust who organise a programme of training, dives, and related Seasearch projects each year. Seasearch has made a huge contribution nationally to marine subtidal data with approximately 800,000 habitat and species records submitted (as of 2021) all of which are publicly available via the National Biodiversity Network.

To take part in Seasearch, scuba divers must be experienced (a minimum of 20 logged dives with a minimum ten being in cold water) and hold a relevant diving qualification (to the level of BSAC Sports Diver, PADI Rescue Diver or equivalent) to ensure their diving is of a high standard to guarantee minimal impact on the environment and sensitive species that may be encountered. Divers must also be qualified as either a Seasearch Observer or the higher level of Seasearch Surveyor to collect high quality and accurate marine biological and physical data which is then transferred to local and national records centres for conservation management use. The Seasearch Observation form requires divers to collect information on the habitats they encounter, both physical characteristics such as substrate, rock type, sediment type and man-made structures, and the marine life, seaweeds, and encrusting animals that create the habitats present. The Seasearch Surveyor form collects more detail on the precise makeup of the physical characteristics of the habitat and allows the assignment of biotope codes to the records collected. Please see Appendix 3 for an example Seasearch Surveyor Form used in the St Austell Bay mapping project.

In addition to biological and physical records, Seasearch divers are trained to accurately record their dive position, using GPS aboard a dive vessel or by using landmarks and finding positions from online software such as Google Earth. Other information such as time, date, name of recorder, water temperature, underwater visibility, dive depth, and dive time are all recorded so that the information collected is a complete record.

Seasearch forms are checked, validated, and verified by the local coordinator and then uploaded to Marine Recorder. As a complete data-set they are then shared to local records centres and to the NBN Atlas, plus are available to the public for use in conservation research and management. For more information on Seasearch please visit www.seasearch.org.uk

Photo 6: St Austell Bay Blue Carbon Mapping Project Seasearch Surveyor dive team, photo by Matt Slater

4.3 Dive Survey Results

Eight dives were successfully carried out during the survey period in September 2022.

Prevailing and persistent southwest winds made travel from the launch site in Fowey to Gerrans Bay impossible (Site 1 and Site 2, Figure 11), therefore the dive sites within Gerrans Bay were not assessed during the survey period. Only one site was surveyed within Veryan Bay (Site 3, Figure 12), again due to weather preventing further trips to the area.

In St Austell Bay, all the pre-defined dive sites were successfully surveyed (Sites 5, 6, 7, 8, 9 and 10, Figure 13). An additional survey site, Site 11 (Figure 15) off Pentewan, was added within Mevagissey Bay because of the inability to reach Gerrans Bay and Veryan Bay due to the weather systems experienced. This site was identified due to suspected seagrass being present which hadn't been surveyed by previous mapping or dive activity.

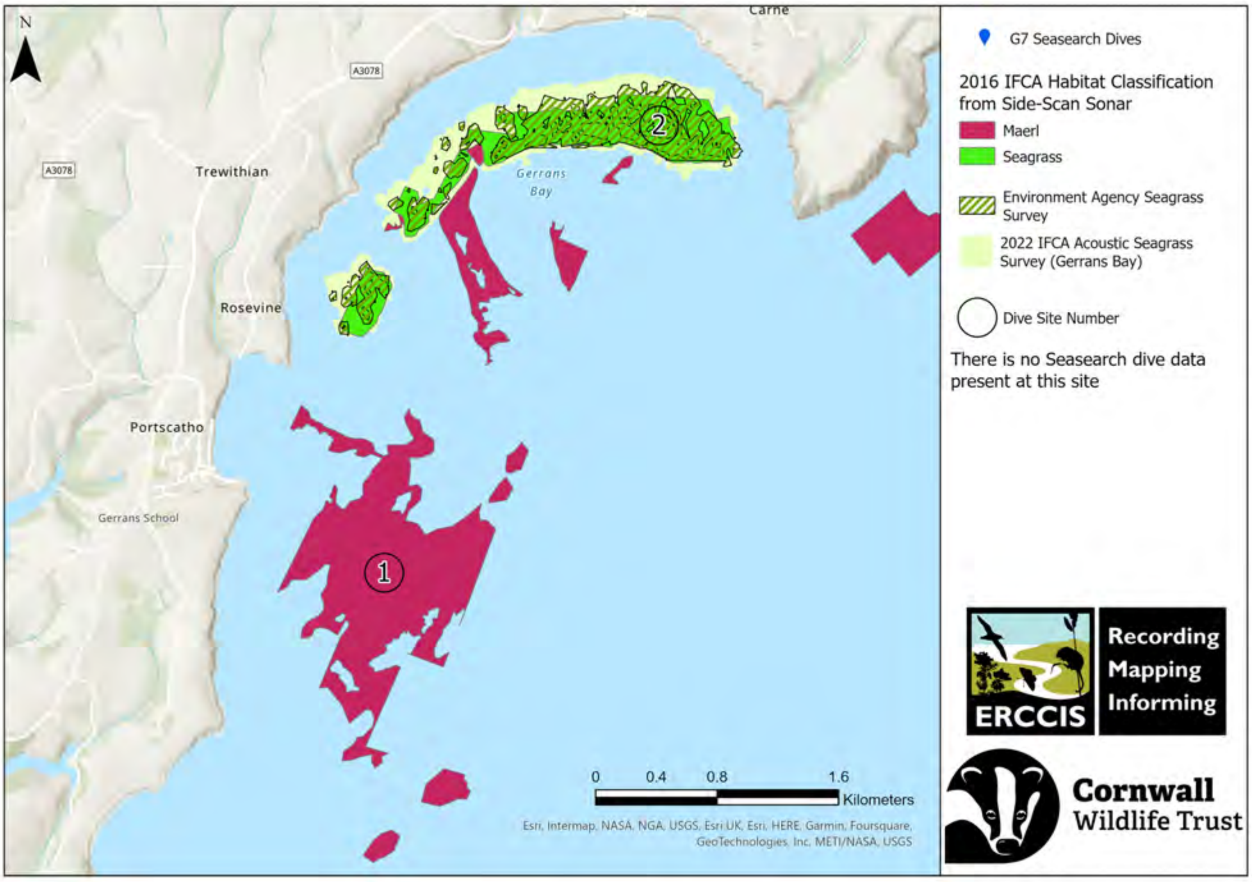

Figure 11: Map of Gerrans Bay showing planned dive sites (numbers within circle) marked on habitat mapping layers. No Seasearch dive data, historic or current, is available for this location.

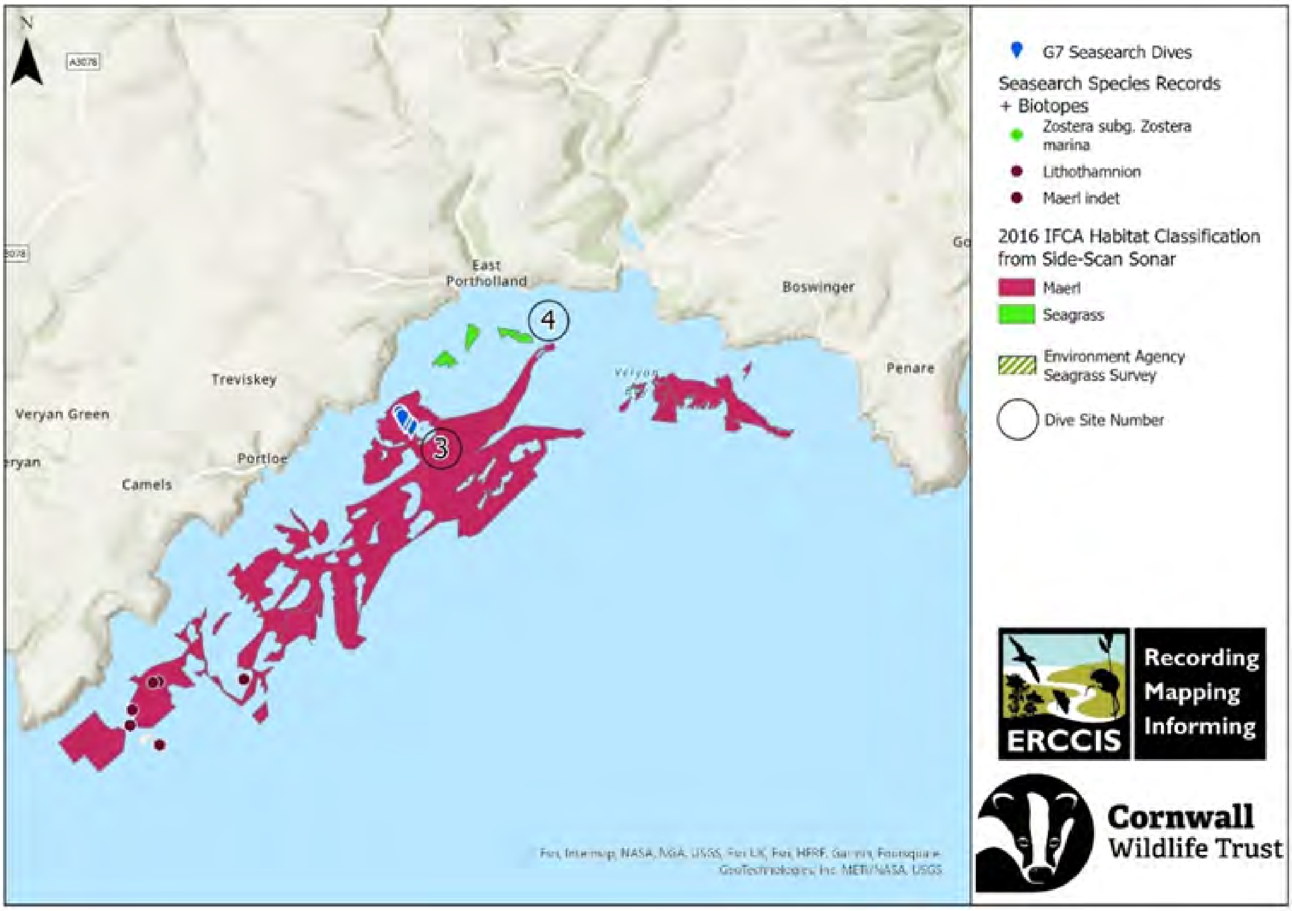

Figure 12: Map of Veryan Bay showing planned dive sites (numbers within circle) and resulting G7 Seasearch dives (blue markers) marked on habitat mapping layers.

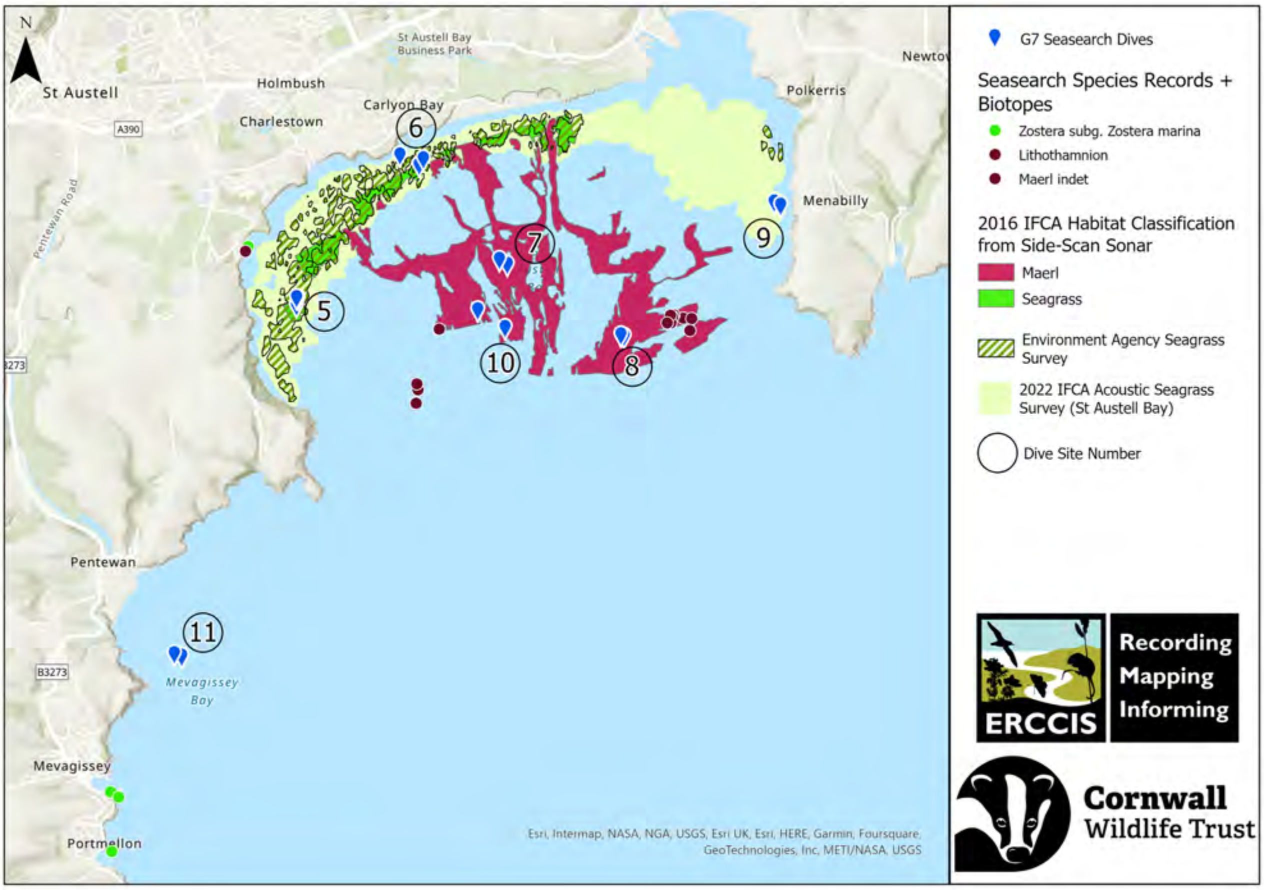

Figure 13: Map of St Austell Bay showing planned dive sites (numbers within circle) and resulting G7 Seasearch dives (blue markers) marked on habitat mapping layers.

4.3.1 Veryan Bay- Dive Site 3

The seabed was waved with shells covered in encrusting pink algae in troughs. Despite this site being in an area where previous acoustic surveys (CIFCA 2016) had identified maerl, no maerl (live or dead) was recorded by any divers at this site. This suggests that this type of seabed may look like maerl if looking using a drop-down camera to validate acoustic signal. Species highlights – Short-snouted seahorse, tub gurnard, and scallops. Full species list can be found in Table 2.

No recorded evidence of human impact, however a gill net fisher was seen working nearby.

The SACFOR scale was used to quantify the abundance of species during the dive. SACFOR stands for Super abundant, Abundant, Common, Frequent, Occasional, and Rare. (https://mhc.jncc.gov.uk/media/1009/sacfor.pdf)

Scientific Name	Abundance	Scientific Name	Abundance
Sponges			
Cliona cellata	O	*Ulosa stuposa*	R
Cnidarians			
Anemonia viridis	R	*Alcionium digitatum*	R
Cereus pedunculatus	R	*Halecium halecium*	o
Hydractinia echinata	R	*Cerianthus lloydii*	R
Adamsia palliata	R		
Worms			
Lanice conchilegra	R	*Sabella pavonina*	R
Chaetopterus sp.	R	*Longissimus longissimus*	O
Myxicola infundibulum	R		
Crustaceans			
Macropodia sp	O	*Maja brachydactyla*	O
Inachus sp	R	*Pagurus prideaux*	O
Pagurus bernhardus	C		
Molluscs			
Pecten maximus	F	*Sepiola atlantica*	R
Eledone cirrhosa	R	*Alloteuthis subulata*	R
Aequepecten opercularis	R	*Razor clam spp*	O
Gibbula magus	R		
Bryozoans			
Crisia sp	O		
Echinoderms			
Marthasterias glacialis	C	*Brittlestars small*	R
Henricia sp	O	*Holothuria forskali*	R
Ophiura sp	O	*Neopentadactyla mixta*	R
Sea squirts			
Diplosoma spongiformae	R	*Ascidella mentula*	R
Ascidella aspersa	R	*Clavalina lepadiformis*	R
Fishes			
Hippocampus hippocampus	R	*Callionymus reticulata*	C
Pomatochistus pictus	C	*Scylorhinus canaliculata*	R
Callionymus lyra	O	*Pomatochistus sp*	C
Ammodytes sp	O	*Raja clavata*	R
Trigla lucerna	R		
Seaweeds			
Stenogramme interuptum	O	*Heterosiphonia plumosa*	O
Plocamium sp	R	*Saccharina latissima*	O
EPA	F	*Diatom*	R
Desmaretsia arculatea	R		

Table 2: Veryan Bay Site 3 species list with relative abundance

4.3.2 St Austell Bay seagrass beds – Site 5, 6 and 9

Porthpean – Site 5: Continuous sparse seagrass bed on gently sloping fine sand (lots of mica) – fronds short (approx. 30-40cm) with bare patches 1-2 m2 across. Density approximately 10 shoots per m2. Lots of dead fronds due to winter die off. Species highlights – broadnosed pipefish, little cuttle Sepiola atlantica, lots of scallops Pecten maximus and Mimachlamys varia, also red speckled anemone Anthopleura balli. No litter or human impacts seen at this site.

Carlyon Bay – Site 6: Sparse seagrass with patchy distribution - fronds approximately 50cm in height. Species highlights – juvenile scallops attached to seagrass fronds, plaice, cuttlefish eggs on seagrass, stalked jellyfish, sand star Astropecten irregularis, and nudibranch Amphorina ferrani. Human impacts at this site included lots of golf balls seen by one buddy pair, plus food packaging (plastic litter).

Gribben Head – Site 9: Sandy seabed with a few patches of sparse seagrass – short fronds approximately 40cm in height. Species highlight red mullet. Potting seen near dive site.

The SACFOR scale was used to quantify the abundance of species during the dive. SACFOR stands for Super abundant, Abundant, Common, Frequent, Occasional, and Rare. (https://mhc.jncc.gov.uk/media/1009/sacfor.pdf)

Photo 7: Red speckled anemone, Anthopleura balli, in St Austell Bay seagrass bed photo by Shannon Moran

Scientific Name	Abundance	Scientific Name	Abundance
Sponges			
Cnidarians			
Anemonia viridis	O	*Urticina felina*	O
Hydractinia echinata	R	*Anthopleura balli*	R
Calvadosia campanulata	R		
Worms			
Lanice conchilegra	O	*Spirobranchus (on crab shell)*	R
Myxicola infundibulum	O	*Sabella pavonina*	O
Bryozoans			
Crustaceans			
Pagurus bernhardus	O	*Palaemon sp*	R
Idotea sp	R	*Maja brachydactyla*	R
Mysidae	R	*Macropodia sp*	R
Molluscs			
Sepia officinalis eggs	R	*Turritella communis*	R
Ensis sp (syphons)	F	*Euspira catena*	R
Pecten maximus	O	*Gibbula magus*	O
Aequepecten opercularis	R	*Gibbula cinerara*	R
Mimachlamys varia	F	*Sepiola atlantica*	R
Topshells on zostera	O	*Elysia viridis (on seagrass)*	R
Tritia reticulata	O	*Tricolia pullus*	R
Amphorina ferrani	R		
Echinododerms			
Marthasterias glacialis	R	*Sand brittlestar (arms visible)*	C
Astropecten irregularis	R	*Echinocardium chordatum*	O
Brittlestar sp	R		
Sea Squirts			
Ascidella aspersa	R	*Diplosoma listeranium*	O
Aplidium punctatum	R	*Didemnum maculosum*	R
Diplosoma spongiformae	O		
Fishes			
Pomatochistus sp	C	*Scyliorhinus canaliculata*	R
Callionymus reticulatus	C	*Pollachius pollachius*	O
Callionymus sp	O	*Raja clavata*	R
Syganthus acus	R	*Mullus surmulletus*	R
Pleuronectes platessa	R	*Syngnathus typhle*	R
Seaweeds			
Desmaretsia aculeata	R	*Rhodophyta sp*	O
Sacchariza latissima	R	*Cladostephus spongiosus*	O
Encrusting pink algae (on seagrass)	F		
Other			
Zostera marina	A		

Table 3: St Austell Bay seagrass bed (Site 5,6 and 9) species list with relative abundance

4.3.2 St Austell Bay maerl – Site 7, 8 and 10

Site 7: Large maerl bed areas with wave formation, consisting of dead maerl at the top of the waves and live maerl in the troughs. Maerl in good condition although some diatom crust was observed. Muddier seabed habitat present next to the maerl areas, with burrows and lots of scallops present, both small and large specimens. Species highlights – Lancelet Branchiostoma, lanceolatum, scallops, maerl, sea mouse, and red mullet.

Site 8: Large waves of maerl covering approximately 80% of survey area. Composition of maerl 60% dead and 40% live, with more live maerl in the troughs of the waves. Some fishing rope found in dive site plus bits of old pots, and bottles. Species highlights – two cuttlefish, one curled octopus, streaked gurnard, and scallops.

Site 10: - Mussel farm edge: Clear maerl bed with waves of live maerl in troughs (50%) and dead fine nodules of maerl on ridges. This changed as we entered the mussel farm to an area of low horizontal rocky reef with pebbles and boulders. Higher diversity of seaweeds and sponges present than on the main maerl beds (site 7 and site 8). Species highlight; Steven's goby Gobius gastevensi, scallops and higher diversity of invertebrates on low rocky reefs beneath mussel farm. Some mussels seen on seabed. No other evidence of human impact.

Unlike the seagrass beds in sites 5, 6 and 9 which were uniform in structure, the three maerl sites all varied in composition and diversity. As such, the species lists are listed separately in Table 4 to represent that variation at each site.

The SACFOR scale was used to quantify the abundance of species during the dive. SACFOR stands for Super abundant, Abundant, Common, Frequent, Occasional, and Rare. (https://mhc.jncc.gov.uk/media/1009/sacfor.pdf)

Photo 8: Lancelet Branchiostoma in St Austell Bay maerl bed, photo by Becky Gill

Scientific Name	Abundance			Scientific Name	Abundance		
	S7	S8	S10		S7	S8	S10
Sponges							
Cliona cellata		R		*Suberites sp*			O
Tethya auranum			O	*Halclona cinerara*			O
Haliclona sp			R	*Raspalia ramosa*			R
Porifera			O				
Cnidarians							
Hydractinia echinata	R	R		*Hydroids sp*			O
Adamsia palliata		R		*Halecium halecium*			R
Urcinia felina			R				
Worms							
Sabella pavonina	R	R	R	*Terebellidae*	R		
Aphrodita aculeata	R			*Polychaeta sp*	O		
Lanice conchilegra	C	O	R	*Spirobranchus sp*	R	C	F
Tubulanus sp	R	R		*Chaetopterus sp*	O	R	
Crustaceans							
Pagurus bernhardus	O	O		*Pagurus cuanensus*			R
Liocarcinus depurator	R	R		*Hommarus gammarus*			R
Molluscs							
Gibbula magus	C	O	R	*Sepiola atlantica*		R	
Pecten maximus	O	F	O	*Bivalva*	R	R	
Ensis sp	O	O		*Sepia officinalis*		R	
Eledone cirrhosa		R		*Euspira catena*			R
Mimachlamys varia		R		*Trivia monacha*			R
Bryozoans							
Tubulipora sp			R				
Echinoderms							
Marthasterias glacialis	F	F	F	*Asterias rubens*			R
Echinocardium chordatum	R			*Echinus esculentus*			R
Ophiura ophiura	R						
Sea squirts							
Ascidella aspersa	O	C	C	*Lissoclinum perforatum*			R
Ascidella mentula			C	*Didemnum maculosum var dentata*			R
Corella parallelogramma	R			*Polyclinida sp*			R
Didemnum coraceaum			R				
Fishes							
Callyonymus sp	C	O	r	*Chelidonichthys lastoviza*		R	
Scyliorhinus stellaris	R			*Syganathus acus*		R	
Pomatochistus sp	C	o	R	*Gobius gastevensi*		R	O
Mullus surmulletus	R	R		*Pomatochistus pictus*		R	
Branchiostoma lanceolatum	R			*Ctenolabrus rupestris*			R
Seaweeds							
Mearl	SA	SA	A	*Calliblepharis jubata*			R
Red Diatom sp	R			*Heterosiphonia plumosa*			O
Corralinacea	O	F	o	*Halopteris filicitina*			R
Soliera chordalis			R	*Chordyecladia erecta*			R

Table 4: St Austell Bay maerl bed (Site 7,8 and 10) species list with relative abundance

4.3.2 Additional site Pentewan - Site 11

Divers were deployed off the south end of Pentewan beach in an area where there have been anecdotal records of seagrass, however no significant seagrass was recorded during the survey dives aside from 5 shoots recorded by two divers over the entire survey area. Species highlight – masked crab. No marine litter or evidence of human impacts seen.

The SACFOR scale was used to quantify the abundance of species during the dive. SACFOR stands for Super abundant, Abundant, Common, Frequent, Occasional, and Rare. (https://mhc.jncc.gov.uk/media/1009/sacfor.pdf)

Species	Abundance	Species	Abundance
Sponges			
Cnidarians			
Hydroid species	R	*Calliactis parasitica*	R
Hydractinia echinata	O		
Worms			
Lanice conchilegra	R	*Spirobranchus* (on crab shell)	R
Sabella pavonina	R		
Bryozoans			
Crustaceans			
Pagurus bernhardus		*Macropodia sp*	R
Mysidae	R	*Corystes cassivelaunas*	R
Maja brachydactyla	O	*Inacus sp*	R
Molluscs			
Aequepecten opercularis		*Tritia reticulata*	
Echinododerms			
Astropecten irregularis	R	*Sand brittlestar (arms visible)*	
Ophiura ophiura	R		
Sea Squirts			
Fishes			
Callionymus sp		*Nerophis lumbriciformis*	
Seaweeds			
Heterosiphonia plumosa			
Other			
Zostera marina	R (about five shoots seen by one buddy pair only)		

Table 5: Additional Site 11 Pentewan species list with relative abundance

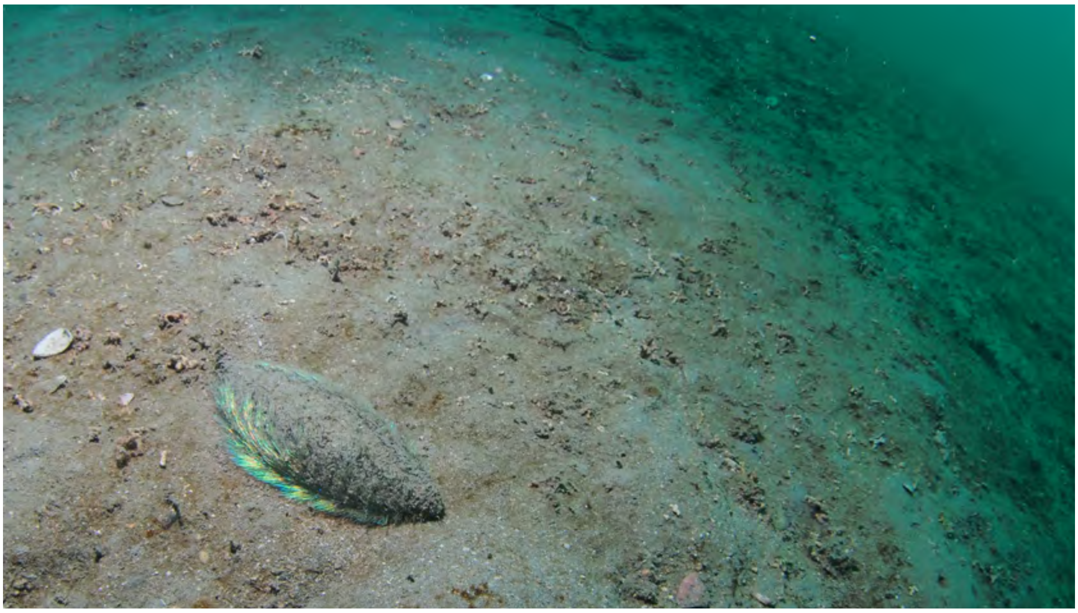

Photo 9 top: Short snouted seahorse, photo by Tom Shelley
Photo 10 middle: Seagrass in St Austell Bay, Photo by Matt Slater
Photo 11 bottom: Sea mouse, photo by Matt Slater

CONCLUSIONS AND RECOMENDATIONS

The St Austell Bay Blue Carbon Mapping Project has provided a significant first step towards understanding the extent and quality of blue carbon habitats in the St Austell Bay area.

As a result of the acoustic surveys conducted by Cornwall Inshore Fisheries and Conservation Authority (IFCA), it is apparent that St Austell Bay is supporting Cornwall's largest known seagrass bed at 359.1 hectares (887 acres). The area of seagrass within St Austell Bay also makes it one of the largest known beds within the UK.

Due to limited project resources, including budget and time, along with the unexpected extent of the seagrass in St Austell Bay which took longer to survey than anticipated, the Veryan Bay seagrass bed was not acoustically surveyed during this research. Poor weather conditions during the project period also resulted in no Seasearch dives being carried out within Gerrans Bay. Both activities require re-visiting to fill these gaps if future funding can be found to undertake further research within the catchment.

The historic datasets show that St Austell Bay, Veryan Bay and Gerrans Bay support significant areas of maerl. However, due to limited project resources, these maerl beds were not re-surveyed using acoustic survey techniques to assess any changes since 2016.

The Seasearch data shows that a total of 66 species were recorded within the maerl dive sites, and a further 56 species within the seagrass dive sites, proving the high biodiversity value of these habitats. Several rare and significant species were discovered during the dive surveys including the short-snouted seahorse Hippocampus hippocampus (a Biodiversity Action Plan species), and the commercially important scallop species Pecten Maximus.

On reviewing the project and its outputs, and seeking input from our project partners, the following list of recommendations have been included to inform next steps and further research priorities for blue carbon habitats in the St Austell Bay and surrounding catchment:

1. There is a need to revisit Gerrans Bay to complete Seasearch dive surveys to complement the 2022 Cornwall IFCA acoustic survey data, as well as a need to revisit Veryan Bay to complete Cornwall IFCA acoustic survey work. In doing so we will enable a greater understanding of the full extent and connectivity between the seagrass beds in the area and other habitats along the Cornish coast. This will provide a fuller dataset to better inform management and restoration activities and assist long-term sustainability of conservation efforts.

2. There is a significant need to prospect additional areas to investigate for currently unknown seagrass beds, particularly around Mevagissey Bay. It is evident that known beds in Cornwall are not strictly limited to areas that are protected from southwest weather systems (Gerrans Bay, Mount's Bay and St Austell Bay being examples), plus historic Seasearch dives show records of the habitat outside of the current mapped area, particularly within more shallow waters. Therefore, we recommend that all suitable soft substrate in and around the shoreward 15-metre contour needs further investigation. Targeted participatory mapping and citizen science efforts could be the basis of a rapid assessment with subsequent further acoustic and in-water surveys carried out to fully map any new beds which may consequently be discovered.

3. This project was unable to re-survey the maerl beds due to a lack of time and funding. Although it is thought unlikely by project partners that the extent of maerl will have changed drastically over the past 7 years since the 2016 Cornwall IFCA surveys, it is felt that there would be benefits in revisiting the sites to repeat the 2016 surveys using side scan sonar, together with drop down camera work, to better determine any mis-identification of maerl habitat and get a comprehensive and updated picture of the extent and quality of maerl in this area of the county.

4. In relation to the use of multiple tools for extent mapping and monitoring, it is agreed that a collaborative approach to future surveys would be beneficial. Complementary survey techniques such as drop-down camera and scuba diving alongside acoustic surveys will achieve the most accurate data on extent, density and canopy height. These combined techniques would also improve the frequency of observations able to be undertaken, and lead to a better understanding of dynamic changes in the condition and extent of these habitats.

5. There is a clear exclusion of survey work, both historic and present day, within the existing West Country Mussels of Fowey mussel farming site (Figure 14). Previous surveys of this site, particularly those done by the National Lobster Hatchery via their Lobster Grower project between 2016 and 2018 (https://www.nationallobsterhatchery.co.uk/lobster-grower/) discovered maerl (Phymatolithon calcareum) within the survey area. It would be beneficial to ensure that any future habitat mapping and biodiversity monitoring in this area includes the mussel farm, and that further research is considered to identify any impact of the farm (both positive and detrimental) on the blue carbon habitats that sit within.

6. In addition to mapping, we recommend that further investigations into the carbon features of the site are undertaken to better understand the carbon stock, including assessment of productivity, storage and rates of sequestration and decay.

7. We recommend the use of baited camera traps to further monitor biodiversity within the habitats surveyed. This would provide a better idea of usage by fish and other mobile species than dive surveys alone will allow.

8. In order to better consider seagrass (and other habitats) through the Natural Capital lens, baseline and monitoring information are needed at local and regional scales including their value in terms of carbon storage, biodiversity and provision of other environmental services (e.g. coastal protection). This requires a holistic approach to research and stronger collaboration between the research conservation communities.

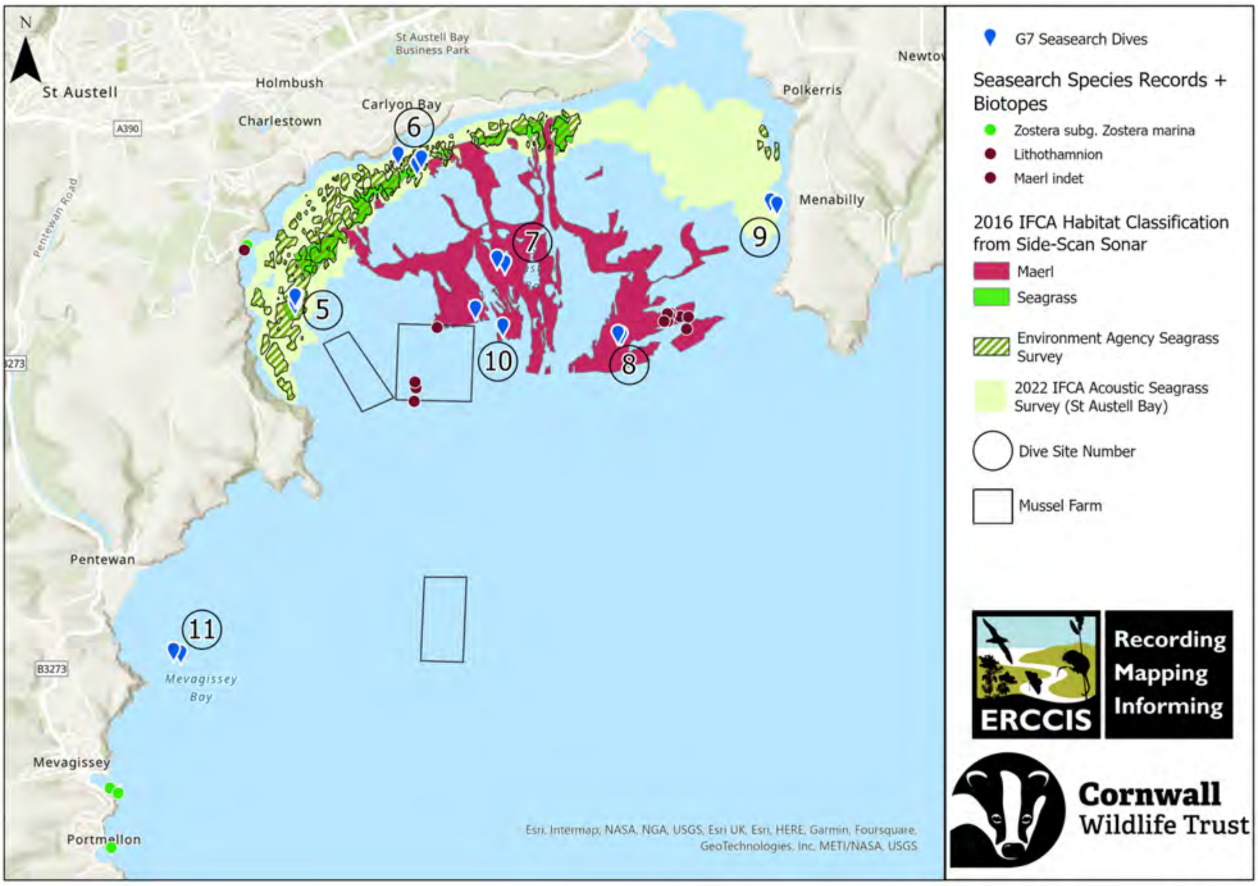

Figure 14: Map of St Austell Bay showing planned dive sites (numbers within circle) and resulting G7 Seasearch dives (blue markers) marked on habitat mapping layers alongside the marked area (black lined boxes) of the West Country Mussels of Fowey farm.

9. Marine nature recovery can be achieved by either active or passive restoration activity, but before restoration of specific habitats can begin, all environmental parameters that may be impacting that habitat must be assessed. For example, it is acknowledged that poor water quality is likely to negatively impact the growth and resilience of seagrass, and unless this is addressed, active restoration activity could be unsuccessful. We therefore recommend that a next step towards restoration of the blue carbon habitats within the St Austell Bay area would be to undertake full environmental monitoring, particularly for water quality, to better understand the potential impacts and inform recovery potential.

10. We must ensure that all data produced as a result of this project and all future 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. However, at a local level, there is currently a Cornwall Marine Data Portal in development (https://marine-hub-cwtrust.hub.arcgis.com/) which provides access to both ecological and environmental focused coastal and marine data, including activity data, which will inform and contribute to environmental planning, management, and protection across the county.

11. St Austell Bay is a vibrant catchment with multiple industries which exist within and beside the marine and coastal area. The second largest fishing port in Cornwall, Mevagissey also supports a diverse fishing fleet that utilize the area. There is a significant need to investigate the benefits that seagrass and maerl habitats provide for the fishing community, plus the risks associated with these industries and activities on the subtidal environment and habitats. Assessment and monitoring of these pressures may highlight options for cost-effective methods to manage these pressures for the protection of seagrass and maerl.

12. St Austell Bay currently only benefits from one formal Marine Protected Area designation – the Special Protection Area (SPA). Understanding the current legislative processes and that further formal designations are unlikely to be assigned to this site in the near future, Cornwall Wildlife Trust recommends that a whole site approach for the management of the SPA is considered thus protecting the associated habitats, in this case the seagrass and maerl, from damaging marine activity such as bottom-towed fishing.

13. In addition to the proposed review of the SPA, management measures to assist the protection and natural regeneration of seagrass and maerl – within and outside of the MPA network – should be considered. This will include making seagrass and other sensitive habitats more visible to sea users through marker buoys, providing mooring alternatives, and making location information more accessible to sea users (please see https://oceanconservationtrust.org/exciting-new-partnership-launched-to-protect-vitally-important-seagrass-meadows/).

14. The facilitation of this project, and the production of this report, has highlighted the significant need for cross-organisation collaboration to effectively map and understand the blue carbon habitats in Cornwall and beyond. There is ever increasing interest in the field, with multiple efforts by agencies (both NGO and government) to further our understanding and evidence. Improvement in communication and collaboration would therefore reduce duplicate efforts and combine to build stronger and more effective conservation and management initiatives. Current work through the 3Cs project – Championing Coastal Collaboration – is looking to address this issue at a county and place-based level and if successful could provide a suitable platform to facilitate this required collaboration.

Photo 12: Seasearch diver over maerl bed with scallop in St Austell Bay, photo by Shannon Moran

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Thank you to our dedicated Seasearch Surveyors who gave up their time as volunteers to assist with the dive surveys and collate valuable records of Cornwall's marine species, habitats, and biotopes.

Thank you to the Ocean Conservation Trust, in particular Andy Cameron, for his input into the recommendations within the report.

Thank you to Cornwall Wildlife Trust's Marine Conservation Apprentice Gemma Newman for her support with the design of this report.

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Front page and back page photo credit: Angie Gall - Seagrass within Carlyon Bay, St Austell.

St Austell Bay Blue Carbon Mapping Project

Authors: A Crosby, M Slater, R Williams, C Trundle and G Newman

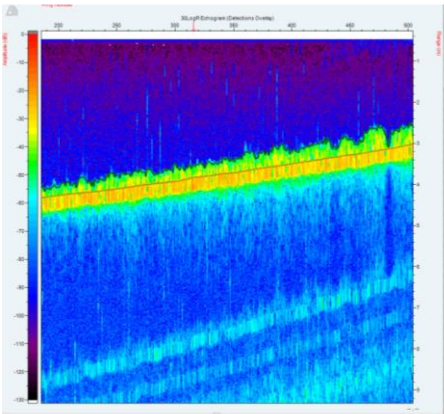
Cited as:
St Austell Bay Blue Carbon Mapping Project. Cornwall Wildlife Trust (CWT). Published March 2023.

For more information about this project or any contents of this report please contact Cornwall Wildlife Trust.

APPENDIX 1

Appendix 1 CIFCA_2022_St.AustellBay_MX_FieldReport_FINAL

Acoustic Survey of the seagrass bed within St Austell Bay 2022



Survey field report for the 2022 Acoustic Survey of the seagrass bed within St Austell Bay

Completed by: Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA)

Authors: Annie Jenkin, Steph Sturgeon and Colin Trundle

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Cornwall IFCA Document Control

Title: 2022 Acoustic Survey of the seagrass bed within St Austell Bay

Version History			
Authors	**Date**	**Comment**	**Version**
A Jenkin	02/09/2022	First draft	0.1
S Sturgeon and C Trundle	03/10/2022	QA	0.2
A Jenkin	04/10/2022	QA comment amendments	Final

Summary

This report summarises the operations and data acquired during the 2022 acoustic survey of the seagrass bed within St Austell Bay. The survey was carried out over six days, 28th July, 4th August, 8th August, 16th August, 18th August and 25th August 2022.

The aim of the survey was to map the extent and coverage of the seagrass bed within St Austell Bay using a Biosonics MX Scientific Echosounder. In total 367 acoustic survey lines were completed of which 356 were included in the analysis.

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Glossary of Terms and Abbreviations

CTD – Conductivity, Temperature, and Depth

EOL – End of Line

IFCA – Inshore Fisheries and Conservation Authority

SPA – Special Protection Area

SOL – Start of Line

1 Background and Introduction

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA) was contracted by Cornwall Wildlife Trust to map the extent of the seagrass within St Austell Bay as part of their blue carbon mapping project. The survey site is within the Falmouth Bay to St Austell Bay Special Protection Area (SPA). This project was funded as part of the G7 Legacy Fund. The contract includes joint intellectual property (IP) of all data collected.

1.1 Aims & Objectives

1.1.1 Aims

- Map the extent of the seagrass bed within St Austell Bay.

1.1.2 Objectives

- Collate database of all known extents of seagrass within St Austell Bay.
- Complete acoustic survey using MX Aquatic Habitat Echosounder in areas of known seagrass.
- Verify acoustic signal in areas where it is difficult to determine if seagrass is present.
- Use Visual Aquatic by Biosonics software to analyse data.
- Use MapInfo Professional Advanced software to create contour plots of plant height (cm) and planet coverage (%).

1.2 Historic data

Table 1 shows previous surveys of the seagrass within St Austell Bay

Table 1: Previous surveys of the seagrass within St Austell Bay seagrass

Year	Company	Methods	Attribute	Measure	Notes	Data currently available
2021	Environment Agency	DDV	Extent	Area (ha) of seagrass >5%		No
2019	Environment Agency	DDV	Extent	Area (ha) of seagrass >5%		Yes
2016	Cornwall IFCA	SSS	Extent	Area (ha) of seagrass	Mapping the extent of the seagrass was not a priority for the survey so full extent was not mapped	Yes

The Cornwall IFCA side-scan polygon 2016 (Jenkin *et al*., 2016) and Environment Agency 2019 (Kenworthy, 2020) data points were uploaded into HYPACK MAX software during the survey planning phase.

A survey was carried out by the Environment Agency in 2021 which covered the western extent of the seagrass bed but Cornwall IFCA was aware of this data set or that further survey work had been carried out within St Austell Bay at the time of survey planning or during the data collection.

No data for St Austell Bay is available on Magic Map Application at the present time (Magic, 2022).

2 Survey Operations

The survey was undertaken aboard the Research Vessel (R/V) Tiger Lily VI. Details of the vessel and the equipment used are provided in 0. Survey operations and protocols are described below.

2.1 Personnel

All survey days consisted of a skipper (either independent or the principal scientific officer from Cornwall IFCA) and one or two scientific officers.

2.2 Personal Protective Equipment (PPE)

While working on deck all crew were required to wear lifejackets, personal location beacons (PLBs) and steel toe cap boots. There were no reported accidents or near misses throughout the survey.

3 Survey Methodology

Previous survey positions (polygons and points) were uploaded onto HYPACK MAX Version 2019 software. For each polygon, survey lines were created depending on the aspect of each individual bed so that the survey lines ran perpendicular where possible to the coastline following the Environment Agency methodology of subtidal seagrass monitoring for the Water Framework Directive (WFD) (Environment Agency, 2019). Each survey line ran further than the known extent of each bed to capture any changes to the bed extent since they were last surveyed. The survey lines were set up with 20 meter line spacing.

Acoustic data was acquired using a MX Aquatic Habitat Echosounder (Appendix 2). The acoustic data was captured using Biosonics' Visual Aquatic (V 6.4) software. Visual Aquatic analyses the E1 and E2 values to provide estimates of submerged aquatic vegetation (including seagrass), substrate and bathymetry. The transducer was deployed over the port side of the vessel via a pole mounted on the side, the pole positioned the transducer approximately one metre below the keel to ensure no part of the vessel caused any acoustic shadowing.

Acoustic data was collected in one survey area to map the extent of the bed.

On arrival within St Austell Bay, a Valeport Swift Sound Velocity Profiler was deployed to measure the Conductivity, Temperature, and Depth (CTD). Once recovered to deck the data was downloaded using Valeport Data log X2 software and the temperature and salinity values from the bottom depth were input into the Visual Acquisition software.

A folder for the survey area was created prior to the deployment of the MX and data was recorded with date and time stamps for each file e.g. 20220728_101003.

A target was created in HYPACK to indicate the start of line (SOL); this was repeated at the end of line (EOL). The speed over ground was aimed to be at a constant of 4.5 knots so that the pings from the MX were at a consistent distance.

4 Data handling

MX SOL and EOL positions, targets for verification and video tow SOL and EOL positions were recorded in the Lat/Long WGS84 projection taken from a single GPS, Hemisphere V500 GNSS system on Tiger Lily VI. HYPACK targets were extracted as a .txt file format and opened in Microsoft Excel (comma delimited).

The video files and raw MX files (.dt4 and .rtpx) were transferred from the PC to a WD Passport for transport and storage at the end of each survey day. The log sheets were worked on from the shared network drive and saved at the end of each day.

5 Cruise Narrative

All times are Universal Time Coordinated (UTC).

28th July 2022

R/V Tiger Lily VI departed Mylor at 07:20 on the 28/07/2022 with an independent skipper, the principal scientific officer and one scientific officer. The vessel initially transited to Gerrans Bay, arriving on site at 07:50 and finishing survey operations at 09:04 before transiting to St Austell Bay. The vessel arrived on site within St Austell Bay at 09:52 and a CTD drop was carried out at 10:08. A total of 39 surevy lines were completed within St Austell Bay (T1 to T38 and T364). The vessel was slowed at the end of T3 to avoid paddleboarders. One line was ended early and was not included in the analysis. The seagrass extended beyond some of the lines inshore but could not be captured due to the depth of water under the vessel. R/V Tiger Lily VI departed the survey site at 16:17 and arrived alongside Mylor at 16:35.

4th August 2022

R/V Tiger Lily VI departed Mylor at 07:40 on the 04/08/2022 with the principal scientific officer as skipper and two scientific officers. The vessel arrived on site within St Austell Bay at 08:50 and a CTD drop was carried out at 08:55. A total of 53 survey lines were completed within St Austell Bay (T39 to T91). One line (T37) was a repeat as it was cut short early on the 28/07/22. Additional lines were added to the survey plan capture the extent of the seagrass bed. The seagrass extended beyond some of the lines inshore but could not be captured due to the depth of water under the vessel. R/V Tiger Lily VI departed the survey site at 14:50 and arrived alongside Mylor at 16:25.

8th August 2022

R/V Tiger Lily VI departed Mylor at 07:40 on the 08/08/2022 with the principal scientific officer as skipper and two scientific officers. The vessel arrived on site within St Austell Bay at 08:59 and a CTD drop was carried out at 09:00. A total of 58 survey lines were completed within St Austell Bay (T92 to T149). At 12:58 Tiger Lily responded to a Pan Pan call for a broken down vessel within St Austell Bay. The vessel was towed to Pentewan then Tiger Lily VI returned to the survey arriving at 14:14 and continuing operations at 14:20. The vessel manoeuvred off lines T105 and T115 to avoid moorings and line T121 to avoid a trailing rope. R/V Tiger Lily VI departed the survey site at 17:05 and arrived alongside Mylor at 18:40.

16th August 2022

R/V Tiger Lily VI departed Mylor at 06:50 on the 16/08/2022 with the principal scientific officer as skipper and two scientific officers. The vessel arrived on site within St Austell Bay at 08:18 and a CTD drop was carried out at 08:34 with a repeated one at 08:45. A total of survey lines were completed within St Austell Bay (T150 to T248). The vessel veered off course on line T239 and was not included in the analysis. T207 was ended early as the vessel veered off course. The seagrass extended beyond one of the lines inshore but could not be captured due to the depth of water under the vessel. R/V Tiger Lily VI departed the survey site at 16:45 and arrived alongside Mylor at 18:45.

18th August 2022

R/V Tiger Lily VI departed Mylor at 06:40 on the 18/08/2022 with an independent skipper, the principal scientific officer and one scientific officer. The vessel arrived on site within St Austell Bay at 07:50 and a CTD drop was carried out at 07:54. A total of 63 survey lines were completed within St Austell Bay (T249 to T310). There was no GPS for the first three tows of the day as the cable was not connected. A prospect line was carried out to find the eastern extent of the seagrass. The seagrass extended beyond one of the lines inshore but could not be captured due to the depth of water under the vessel. The pole mount struck an uncharted obstacle at 12:20 resulting in a bend to the pole. The transducer was repositioned to account for the bend in the pole and the survey continued. The sea state picked up at the end of the day which caused the data to be unusable due to the roll of the vessel, these tows were not included in the analysis. R/V Tiger Lily VI departed the survey site at 13:40 and arrived alongside Mylor at 16:05.

25th August 2022

R/V Tiger Lily VI departed Mylor at 07:15 on the 25/08/2022 with the principal scientific officer as skipper and two scientific officers. The vessel arrived on site within St Austell Bay at 08:45 and a CTD drop was carried out at 08:50. A total of 53 survey lines were completed within St Austell Bay (T311 to T363). The seagrass extended beyond some of the lines inshore but could not be captured due to the depth of water under the vessel or obstacles in the water. The lines were carried out at 40 m line spacing to cover the extent of the bed in the time available within the budget of the project. R/V Tiger Lily VI departed the survey site at 16:01 and arrived alongside Mylor at 17:25.

6 Acoustic Data acquisition

Acoustic imagery was acquired at one seagrass bed within St Austell Bay. A summary of the data collected can be found in Table 2. A total of 367 survey lines were completed, 356 lines of which were included in the data analysis.

Table 2: MX line metadata for the 2022 survey of the seagrass within St Austell Bay

Seagrass bed	Number of lines	Number of lines included in data analysis	Reason why discounted
St Austell Bay	367	356	20220728 1 x line • Line 234 – EOL early. Re-done on 20220804 20220816 1 x line • Line 34 – EOL early as vessel veered off course. 20220818 9 x lines • Line 25 – No GPS connected. • Line 24 – No GPS connected. • Line 23 – No GPS connected. • SSE to NNW (line 23). Seagrass. Repeat of line 23 - T252, removed line from analysis. • Extra line – 2 x Prospect line. Extent of seagrass covered by other lines • Extra line SSE to NNW– Roll of vessel shown in data due to increased sea state, data unusable • Extra line NNW to SSE – Roll of vessel shown in data due to increased sea state, data unusable • Extra line SSE to NNW– Roll of vessel shown in data due to increased sea state, data unusable

For vessel and equipment specifications see Appendix 1. The daily logs are available on request.

The MX lines completed are shown in Figure 1. The different blue colouring of the lines denotes the orientation of the data capture, i.e. either towards the shore or away from the shore.

6.1 St Austell Bay

Figure 1: Acoustic survey lines completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022.

7 Data analysis

All lines for each bed were loaded into Biosonics' Visual Aquatic software in a batch, then analysed individually. The threshold for the bottom line, plant line as well as the plant length detection criteria (cm) were analysed for each line in the bed using the same settings (Table 3).

Table 3: Threshold settings for Visual Aquatic and the plant length detection criteria (cm) for each seagrass bed surveyed by Cornwall IFCA

Seagrass bed	Rising edge threshold Db (bottom line)	Plant detection threshold dB (plant line)	Plant detection length criterion (cm)
St Austell Bay	-40	-60	10

An example of the bottom line (orange) and plant line (green) in areas of varying seagrass collected within St Austell Bay can be seen in Figure 2.

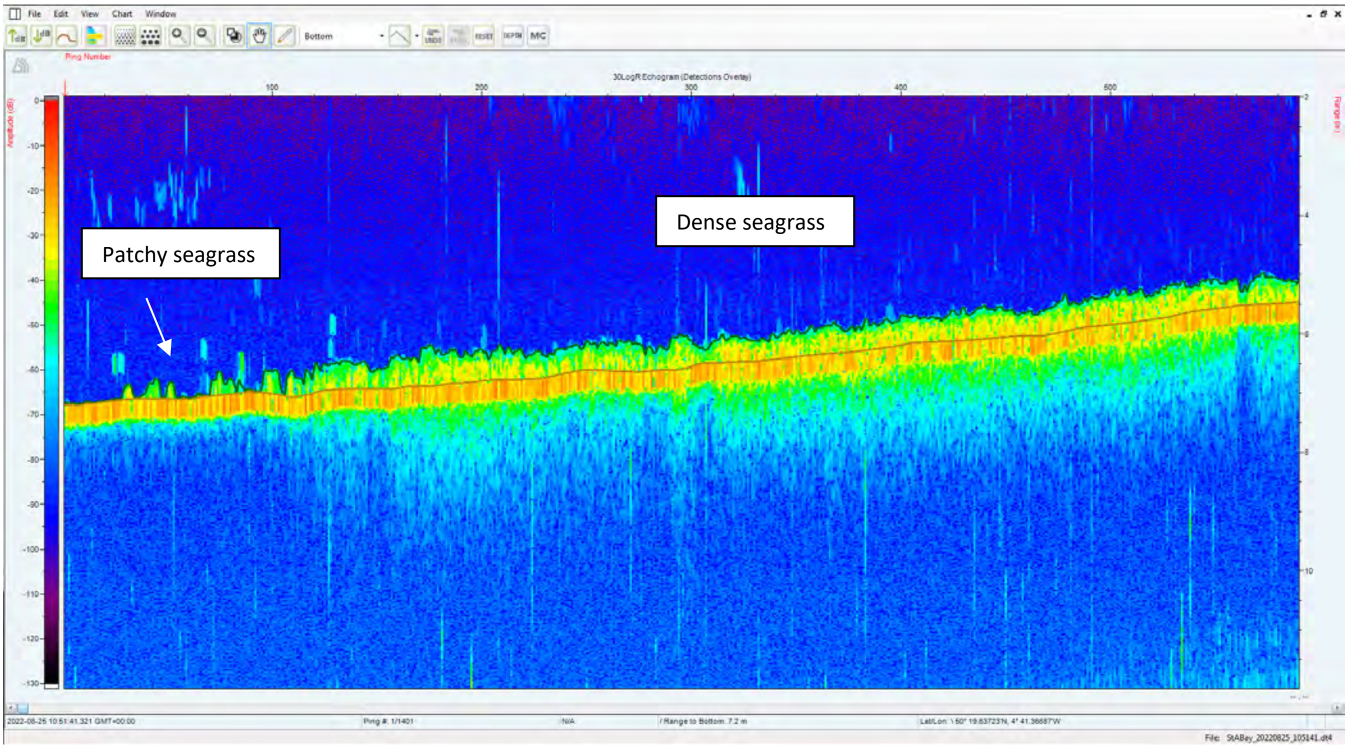


Figure 2: Bottom line (orange) and Plant line (green) in Visual Aquatic by Biosonics software in a dense seagrass bed and patchy seagrass within St Austell Bay.

Quality assurance (QA) was carried out for tows individually and the bottom line and plant line were manually adjusted where there were errors. The plant line was adjusted when anything other than seagrass was present such as algae, noise in the water column when the vessel was turning and fish in the water column.

Once each line was corrected, the post processing information was recorded in the survey log. The analysed data were exported from Visual Aquatic as a .csv file. Each data point in the .csv file represented the average values of ten consecutive acoustic pings. The data was copied to Microsoft Excel pasted to columns with corrected headers including latitude, longitude, date, time and notes. This was saved as a .xls file and imported into MapInfo Professional Advanced (Version 17.0.4) to create points.

A theme was added to the points data for the plant height (m) and the plant coverage (%). A polygon was drawn around each survey area clipped to the point at the start and end of each tow. A raster was created using the natural neighbour function for plant height (m) and plant coverage (%). The settings for the raster were distance: 20 m, smoothing: 0, clipped to polygon for each survey area, cell size: user suggested and interpolated along edges. Advanced colour was used to define the colour scales.

Plots for points of plant height (m), percentage cover (%) of seagrass, contour plot of plant height (m) and the contour plot of percentage cover of seagrass (%) are shown in Figure 3 to Figure 6.

7.1 St Austell Bay

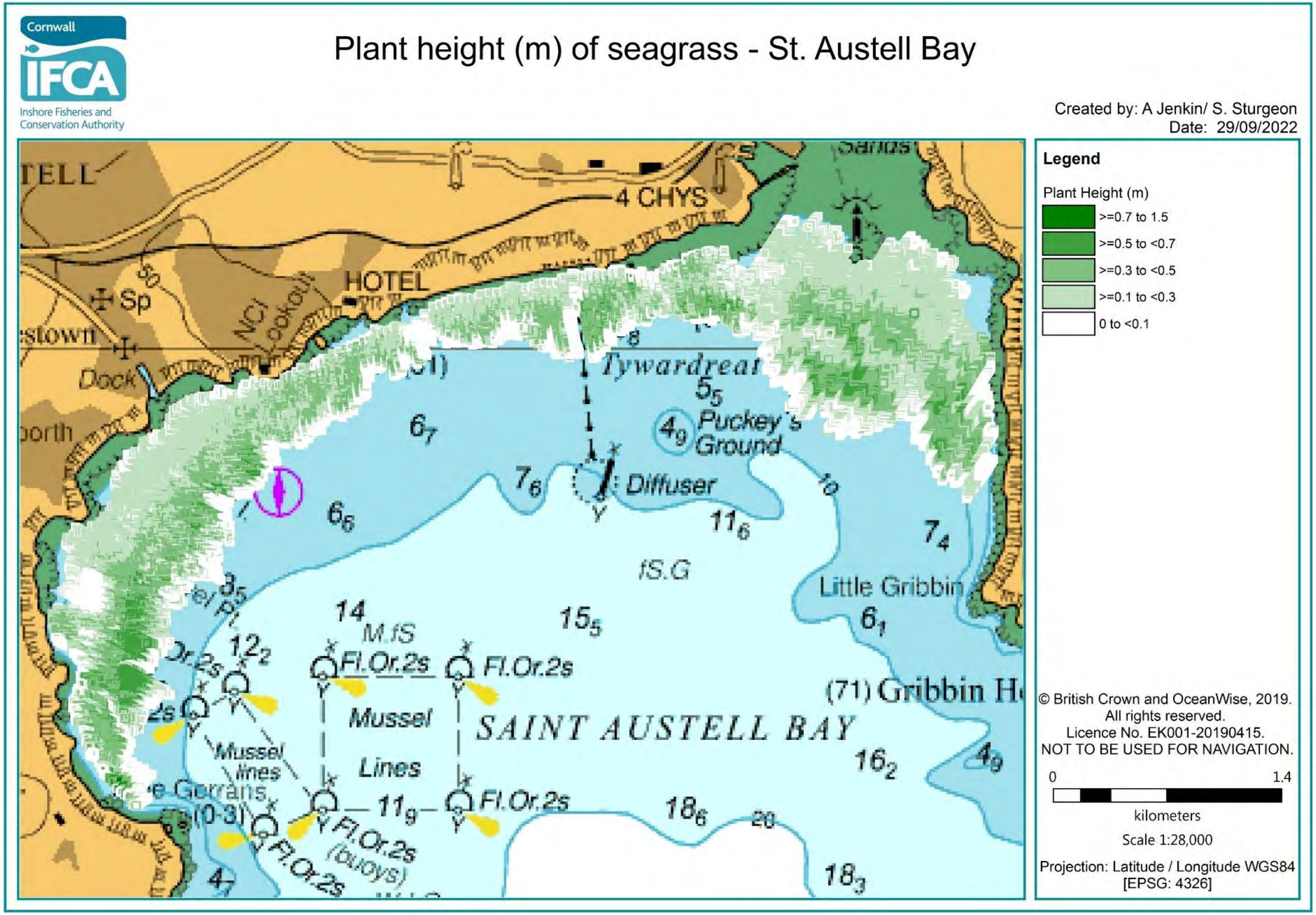


Figure 3: Plant height (m) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

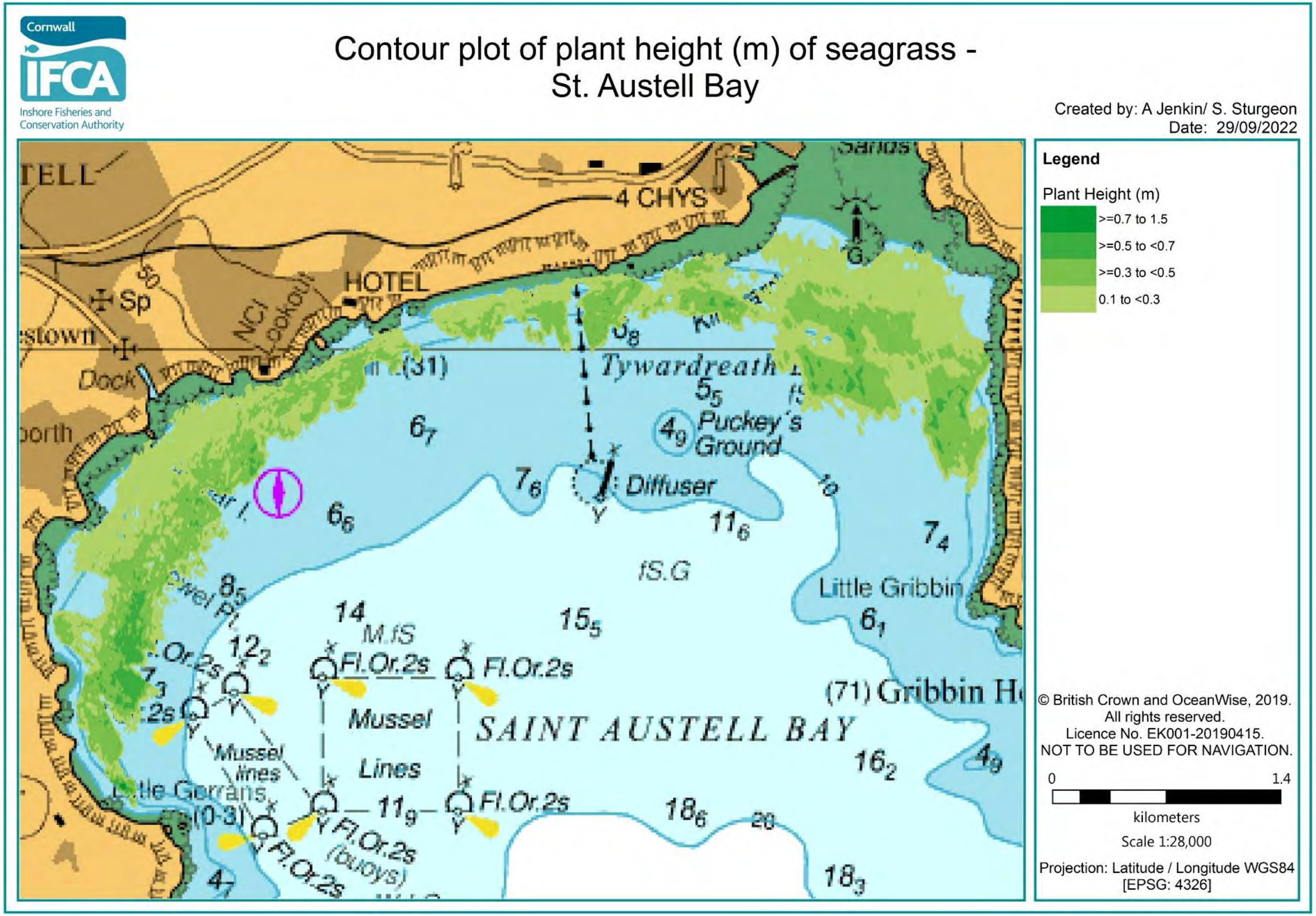


Figure 4: Contour plot displaying plant height (m) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

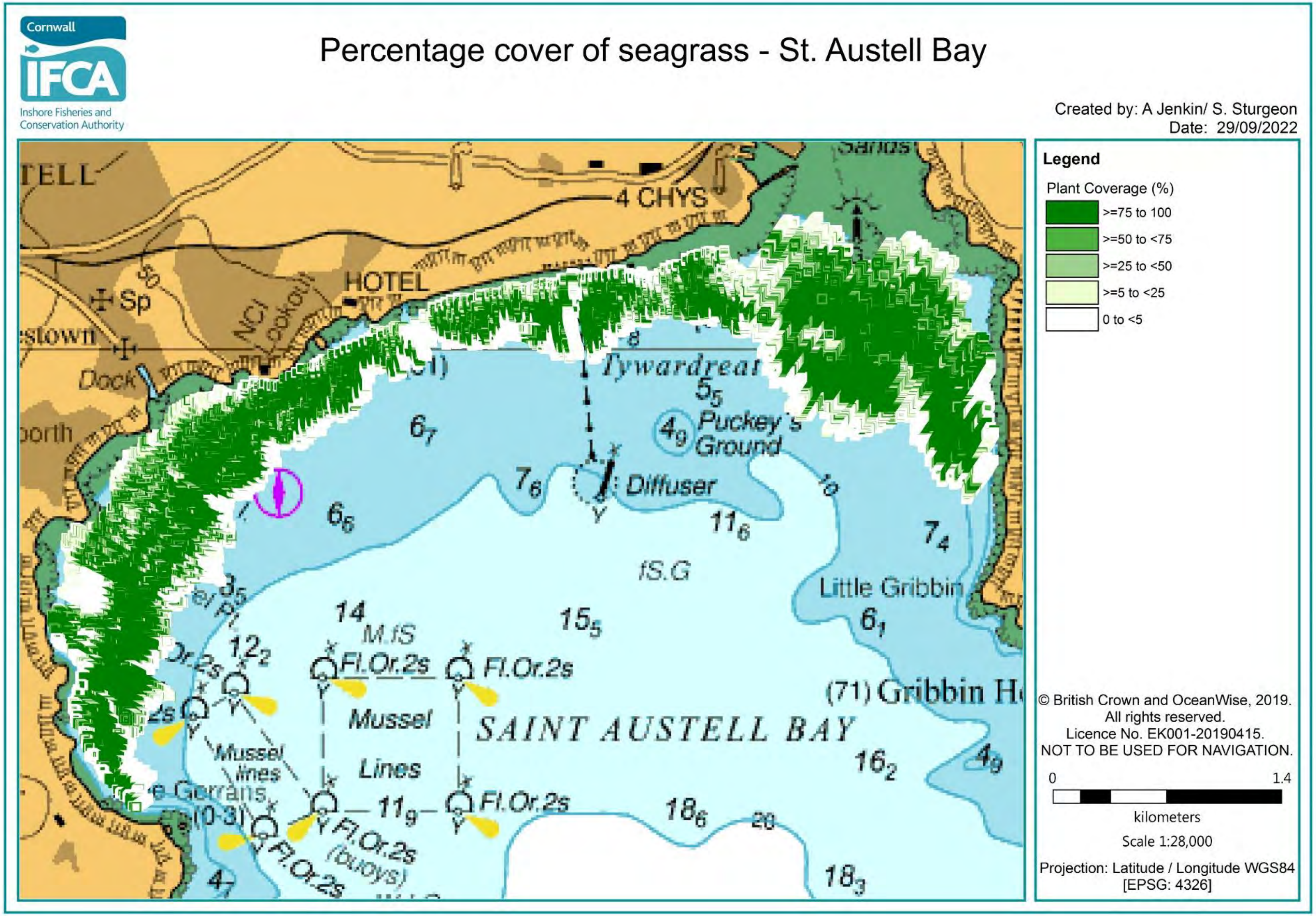


Figure 5: Plant coverage (%) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

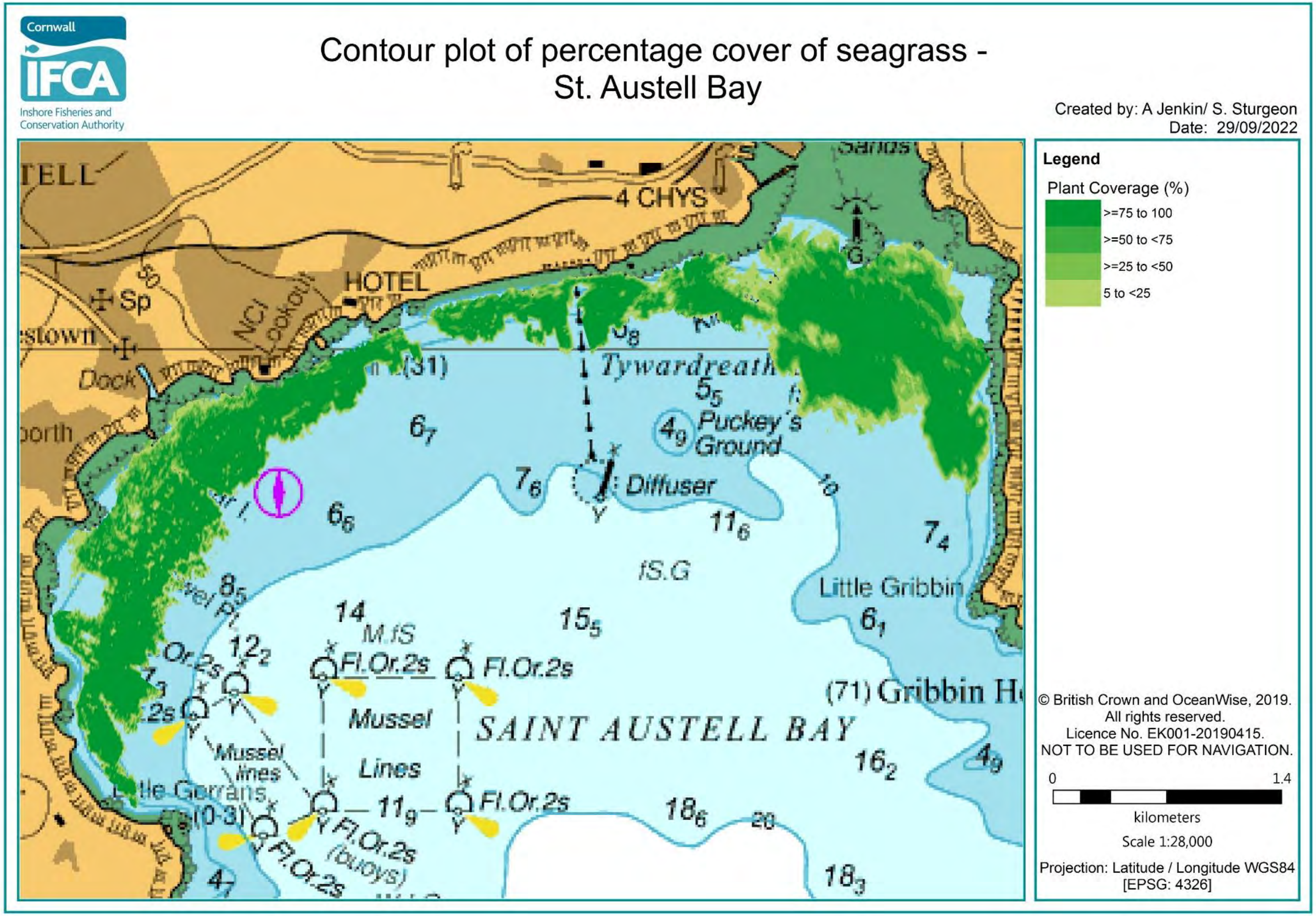


Figure 6: Contour plot displaying plant coverage (%) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

7.2 Area (ha) of seagrass surveyed

The area (ha) of plant coverage >=5% to 100% was calculated by converting the raster from the percentage coverage using the polygonise tool in MapInfo Professional Advanced (Version 17.0.4) to draw a polygon displaying seagrass coverage from >=5 to 100%.

The area (ha) of plant coverage >5% the St Austell Bay seagrass bed is shown in Table 4.

Table 4: The area (ha) of seagrass >=5% to 100% plant coverage within St Austell Bay as surveyed by Cornwall IFCA 2022

Seagrass bed	Area (ha) of seagrass >=5% to 100% plant coverage
St Austell Bay	359.1

8 Discussion

The 2022 survey provided an updated extent, plant height (cm) and estimated plant coverage (%) of the seagrass bed within St Austell Bay. The total extent of the seagrass (>=5% to 100%) coverage within St Austell Bay (ha) was calculated as 359.1 ha.

9 Limitations

There were a number of limitations to the survey which included;

- The plant height (m) should not be taken as the absolute plant height as seagrass fronds are generally unable to stand vertical in the water column. This is increased with frond length.
- The landward extent of the seagrass bed may not be fully mapped as the draught of the vessel limited how shallow the vessel can operate.
- If the vessel rolls due to increased sea state or the passing of another vessels wake, it can cause similar 'waves' in the data as the Biosonics MX does not have any motion stabilisation. Data that has been subjected to excess rolling can present difficulties in accurately determining if seagrass is present.
- The lines in the eastern part of the seagrass bed were carried out with 40 m line spacing instead of 20 m due to time constraints of the project to ensure the full extent was mapped which is an inconsistency in the data gathering.

10 Recommendations

Ideally the survey would run concurrently with a drop-down video survey with positions set out in a gridded system to verify the acoustic signature at frequent intervals. However, it is recognised that this would increase the time and financial resources required to replicate these surveys at this data capture resolution.

11 References

Environment Agency, 2019. Subtidal seagrass monitoring for the Water Framework Directive (WFD).

Jenkin A., Street, K, Matthews R., Trundle C and Naylor, H. Verifying acoustic signals for habitat classification within St Austell Bay, Veryan Bay and Gerrans Bay. 2016 Summary Report. Cornwall Inshore Fisheries and Conservation Authority.

Kenworthy, J. 2020. Whitsand and Looe Bay, St Austell Bay and Fowey Subtidal Seagrass Surveys 2019. Estuarine and Coastal Monitoring and Assessment Service, Environment Agency.

MagicMap, 2022. Defra Magic Map Application. Available from: https://magic.defra.gov.uk/magicmap.aspx [Accessed 19/07/2022]

Visual Aquatic, 2022. Post-processing and data visualisation software for Biosonics echosounder systems.

Visual Acquisition MX, 2022. Real-time data acquisition and playback software for Biosonics MX Echsounder Systems.

12 Appendices

Appendix 1 - R/V Tiger Lily VI Deck Plan, Positioning Software Offsets and Equipment Specification

The survey was undertaken from Cornwall IFCA's Research Vessel (R/V) Tiger Lily VI (Annex Figure A). Tiger Lily VI is an MCA coded Cat 2 vessel. The vessel has been refitted for survey work and includes a purpose built survey station within the wheelhouse. R/V Tiger Lily VI has been fitted with an inverter and uninterruptable power supply (UPS) to provide stable, continuous 240 v power, NMEA outputs and a dedicated GPS with WAAS enabled. All times are recorded as UTC and taken from the same source as the position data. The clocks on all of the data capture PCs were synched prior to departing the vessel's mooring.

Annex Figure A: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

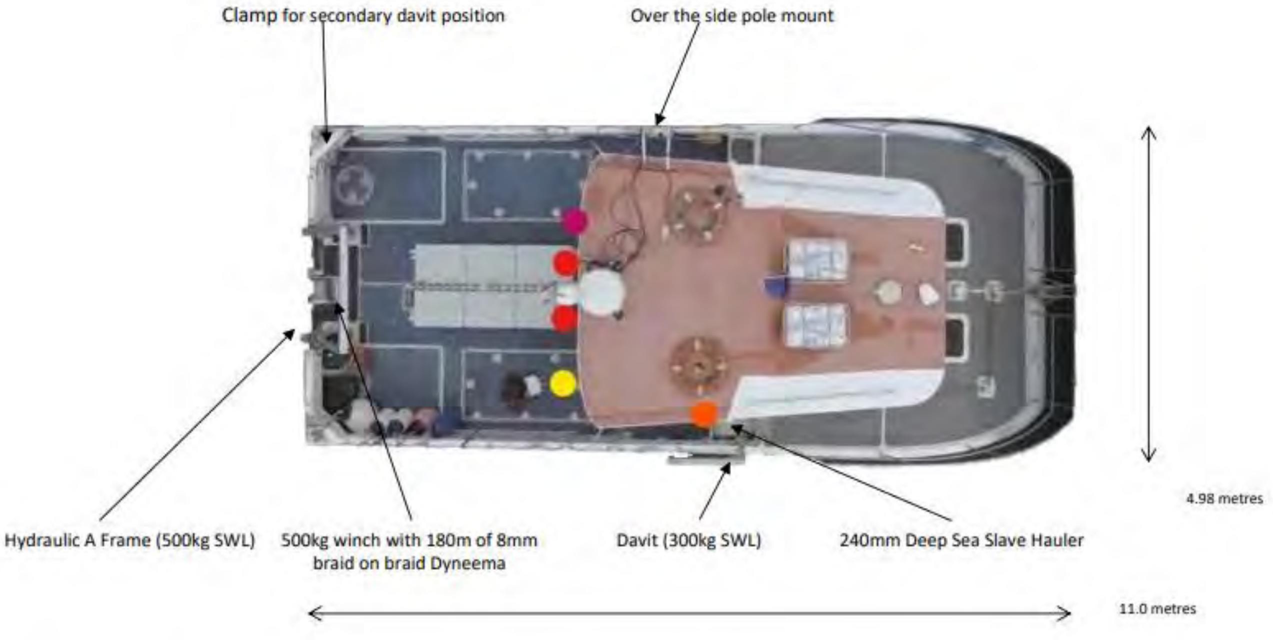
Annex Table A: Specification of R/V Tiger Lily

Builder	South Boats Ltd
Model	Island MkII
Built	2007
LOA	11.0m
Beam	4.98m
Draught	1.1m (aft)
Tonnage	c.10 tonnes
Area of operation	MCA Category 2
Call sign	MRWR7
MMSI Number	235054954
MECAL Certification number	M07WB0111059
Complement	14 (including min 2 crew)
Propulsion	2 x 450hp Iveco NEF series
Speed	Cruising: 16 – 18 knots Top: 24 – 26 knots
Range	c. 400 nautical miles
240v AC supply	Victron 3Kw power inverter

	5KvA Volvo-Perkins generator (All 240 AC power is accessed via APC Smart UPS C1500)
Stern Gantry	500kg SWL
Winch (on stern gantry)	Spencer Carter 0.5t with scrolling level wind
Slave hauler	Sea Winch 200m dia.
Electric line hauler	12v Spencer Carter Bandit
Positioning	Hemisphere V500 GNSS 3 x Furuno GP32
NMEA data outputs	4 x USB 4 x Serial 4 x banjo
Navigation	Olex with data export Knockle Hypack Max
Connectivity	SATFI 4G Mobile broadband

CIFCA_2022_Acoustic Survey of the seagrass bed within St Austell Bay

Positioning Software and Offsets



Annex Figure B: Positioning software and offsets on the deck of R/V Tiger Lily

Annex Table B: Positioning software and offsets onboard R/V Tiger Lily

Equipment				Offset (m)		
NMEA Device	**Plan Symbol**	**Make/Model**	**Offset Name**	**X (Forw'd)**	**Y (Port)**	**Z (+/-)**
Navigation depth sounder	(yellow)	Furuno Navnet	Furuno transducer	7.0m	0.75m	- 0.5m
GPS	(red)	Furuno GP32 x 2	Furuno mushroom antenna	4.8m	2.1m & 2.35m	+ 3.5m
GPS	(orange)	Furuno GP32	Furuno mushroom antenna	3.5m	0.5m	+ 2.0m
GNSS	(magenta)	Hemisphere V500	Main GPS	4.8m	3.0m	+ 2.5m

MX Aquatic Habitat Echosounder

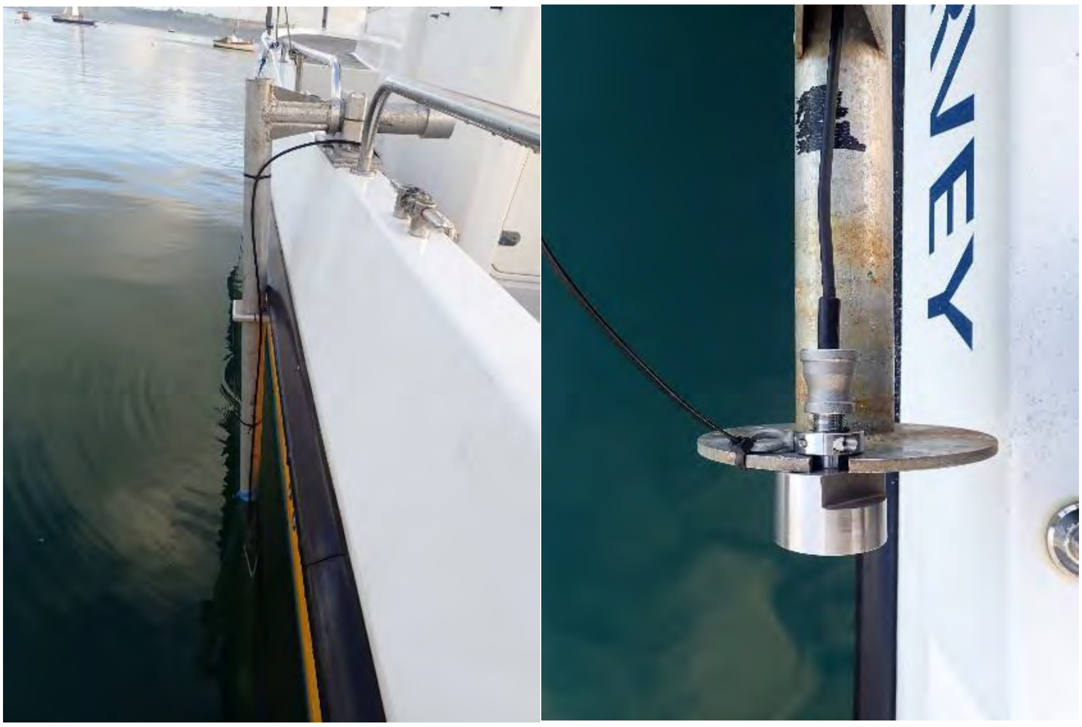
Details of the system are shown in Annex Table C and are available online:

https://www.biosonicsinc.com/wp-content/uploads/2020/09/BioSonics-MX-Spec-Sheet.pdf

Annex Figure C shows the pole mount and MX Acoustic Echosounder on the port side of R/V Tiger Lily VI.

Annex Table C: Equipment specification of the BioSonics MX Aquatic Habitat Echosounder

Specification	Details
Manufacturer	BioSonics
Transducer	Single frequency 204.8kHz Beam angle 8.5 degree conical
Transmit Power	105 Watts RMS
Input power	12-18 VDC or 85-264 VAC
Draw	5 Watts, Fuses: 1 Amp AC 1.5 Amp DC
Transmit source level	213 dB re 1uPa
Pulse length	0.4ms, Ping rate 5Hz
Range resolution	1.7cm
Accuracy	1.7cm +/- 0.2% of depth
Depth range:	0-100m
Operating condition:	0-50 °C
DGPS positional accuracy:	<3m, 95% typical
DGPS velocity accuracy:	0.1 knot RMS
DGPS update rate:	1 sec



Annex Figure C: Pole mount and MX Acoustic Echosounder onboard R/V Tiger Lily VI

Valeport Swift Sound Velocity Profiler

Details of the system are shown in Annex Table D and are available online:

https://www.valeport.co.uk/content/uploads/2022/05/Valeport-SWiFT-CTD-Datasheet.pdf

Annex Table D: Equipment specification of the Valeport Swift Sound Velocity Profiler

Specification	Details
Manufacturer	Valeport
Conductivity	
Range	0-80 mS/cm
Resolution	0.001 m/s
Accuracy	±0.01 m/s
Temperature	
Range	-5°C – +35°C
Resolution	0.001°C
Accuracy	±0.01°C
Pressure	
Range	50 Bar
Resolution	0.001% FS
Accuracy	±0.01% FS

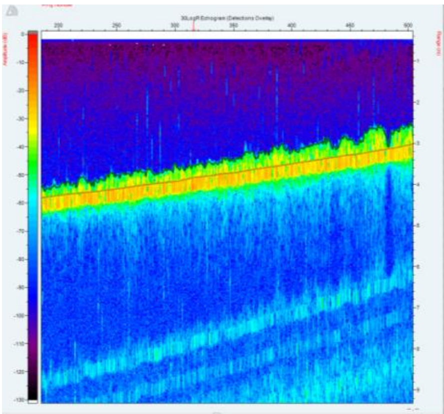
Annex Figure D: Valeport Swift Sound Velocity Profiler deployed from R/V Tiger Lily VI

APPENDIX 2

Appendix 2 CIFCA_2022_GerransBay_MX_FieldReport_FINAL

Cornwall IFCA
Inshore Fisheries and Conservation Authority

Acoustic Survey of the seagrass bed within Gerrans Bay 2022



Survey field report for the 2022 Acoustic Survey of the seagrass bed within Gerrans Bay

Completed by: Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA)

Authors: Annie Jenkin, Steph Sturgeon and Colin Trundle

Cited as:

Jenkin, A., Sturgeon S and Trundle, C. 2022. Acoustic survey of the seagrass bed within Gerrans Bay Field Report. Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA), Hayle.

This document has been produced by Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA)

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Cornwall IFCA Document Control

Title: 2022 Acoustic Survey of the seagrass bed within Gerrans Bay

Version History			
Authors	**Date**	**Comment**	**Version**
A Jenkin	02/09/2022	First draft	0.1
S Sturgeon and C Trundle	03/10/2022	QA	0.2
A Jenkin	04/10/2022	QA comment amendments	Final

Summary

This report summarises the operations and data acquired during the 2022 acoustic survey of the seagrass bed within Gerrans Bay. The survey was carried out over four days, 20th July 2022, 22nd July 2022, 27th July 2022 and 28th July 2022.

The aim of the survey was to map the extent and coverage of the seagrass bed within Gerrans Bay using a Biosonics MX Scientific Echosounder. In total 170 acoustic survey lines were completed, all of which were included in the analysis.

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Glossary of Terms and Abbreviations

CTD – Conductivity, Temperature, and Depth

EOL – End of Line

IFCA – Inshore Fisheries and Conservation Authority

SPA – Special Protection Area

SOL – Start of Line

1 Background and Introduction

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA) was contracted by Cornwall Wildlife Trust to map the extent of the seagrass within Gerrans Bay as part of their blue carbon mapping project. The survey site is within the Falmouth Bay to St Austell Bay Special Protection Area (SPA). This project was funded as part of the G7 Legacy Fund. The contract includes joint intellectual property (IP) of all data collected.

1.1 Aims & Objectives

1.1.1 Aims

- Map the extent of the seagrass bed within Gerrans Bay.

1.1.2 Objectives

- Collate database of all known extents of seagrass within Gerrans Bay.
- Complete acoustic survey using MX Aquatic Habitat Echosounder in areas of known seagrass.
- Verify acoustic signal in areas where it is difficult to determine if seagrass is present.
- Use Visual Aquatic by Biosonics software to analyse data.
- Use MapInfo Professional Advanced software to create contour plots of plant height (cm) and planet coverage (%).

1.2 Historic data

Table 1 shows previous surveys of the seagrass within Gerrans Bay.

Table 1: Previous surveys of the seagrass within Gerrans Bay seagrass

Year	Company	Methods	Attribute	Measure	Notes	Data currently available
2021	Environment Agency	DDV	Extent	Area (ha) of seagrass >5%		Yes
2016	Cornwall IFCA	SSS	Extent	Area (ha) of seagrass	Mapping the extent of the seagrass was not a priority for the survey so full extent was not mapped	Yes

The Cornwall IFCA side-scan polygon 2016 (Jenkin *et al.*, 2016) and Environment Agency 2021 (Green, 2021) data points were uploaded into HYPACK MAX software during the survey planning phase.

No data for Gerrans Bay is available on Magic Map Application at the present time (Magic, 2022).

2 Survey Operations

The survey was undertaken aboard the Research Vessel (R/V) Tiger Lily VI. Details of the vessel and the equipment used are provided in **0**. Survey operations and protocols are described below.

2.1 Personnel

All survey days consisted of a skipper (either independent or the principal scientific officer from Cornwall IFCA) and one or two scientific officers.

2.2 Personal Protective Equipment (PPE)

While working on deck all crew were required to wear lifejackets, personal location beacons (PLBs) and steel toe cap boots. There were no reported accidents or near misses throughout the survey.

3 Survey Methodology

Previous survey positions (polygons and points) were uploaded onto HYPACK MAX Version 2019 software. For each polygon, survey lines were created depending on the aspect of each individual bed so that the survey lines ran perpendicular where possible to the coastline following the Environment Agency methodology of subtidal seagrass monitoring for the Water Framework Directive (WFD) (Environment Agency, 2019). Each survey line ran further than the known extent of each bed to capture any changes to the bed extent since they were last surveyed. The survey lines were set up with 20 meter line spacing.

Acoustic data was acquired using a MX Aquatic Habitat Echosounder (Appendix 2). The acoustic data was captured using Biosonics' Visual Aquatic (V 6.4) software. Visual Aquatic analyses the E1 and E2 values to provide estimates of submerged aquatic vegetation (including seagrass), substrate and bathymetry data. The transducer was deployed over the port side of the vessel via a pole mounted on the side, the pole positioned the transducer approximately one metre below the keel to ensure no part of the vessel caused any acoustic shadowing.

Acoustic data was collected in one survey area to map the extent of the bed.

On arrival within Gerrans Bay, a Valeport Swift Sound Velocity Profiler was deployed to measure the Conductivity, Temperature, and Depth (CTD). Once recovered to deck the data was downloaded using Valeport Data log X2 software and the temperature and salinity values from the bottom depth were input into the Visual Acquisition software.

A folder for the survey area was created prior to the deployment of the MX and data was recorded with date and time stamps for each file e.g. 20220728_080534.

A target was created in HYPACK to indicate the start of line (SOL); this was repeated at the end of line (EOL). The speed over ground was aimed to be at a constant of 4.5 knots so that the pings from the MX were at a consistent distance.

4 Data handling

MX SOL and EOL positions, targets for verification and video tow SOL and EOL positions were recorded in the Lat/Long WGS84 projection taken from a single GPS, Hemisphere V500 GNSS system on Tiger Lily VI. HYPACK targets were extracted as a .txt file format and opened in Microsoft Excel (comma delimited).

The video files and raw MX files (.dt4 and .rtpx) were transferred from the PC to a WD Passport for transport and storage at the end of each survey day. The log sheets were worked on from the shared network drive and saved at the end of each day.

5 Cruise Narrative

All times are Universal Time Coordinated (UTC).

20th July 2022

R/V Tiger Lily VI departed Mylor at 08:15 on the 20/07/2022 with the principal scientific officer as skipper and two scientific officers. A work experience student was also onboard. The vessel arrived on site within Gerrans Bay at 08:55 and a CTD drop was carried out at 9:03. A total of 36 survey lines were completed within Gerrans Bay (T1 to T36). A prospect line was carried out running NE to SW to find the extent of the seagrass. R/V Tiger Lily VI departed the survey site at 15:00 and arrived alongside Mylor at 15:45.

22nd July 2022

R/V Tiger Lily VI departed Mylor at 07:17 on the 22/07/2022 with an independent skipper, the principal scientific officer and two scientific officers. A work experience student was also onboard and a member of staff from Natural England who was previously on the Cornwall IFCA committee. The vessel arrived on site within Gerrans Bay at 07:55 and a CTD drop was carried out at 08:00. A total of 63 survey lines were completed within Gerrans Bay (T37 to T99). Three verification tows were carried out with an HDCam to identify a signature on the sounder. A power cut onboard cause T52 to end early. R/V Tiger Lily VI departed the survey site at 14:38 and arrived alongside Mylor at 15:25.

27th July 2022

R/V Tiger Lily VI departed Mylor at 07:50 on the 27/07/2022 with the principal scientific officer as skipper and two scientific officers. The vessel arrived on site within Gerrans Bay at 08:25 and a CTD drop was carried out at 08:28. A total of 58 survey lines were completed within Gerrans Bay (T100 to T157). The vessel manoeuvred off lines T107 to avoid a buoy with a trailing rope. R/V Tiger Lily VI departed the survey site at 14:20 and arrived alongside Mylor at 15:05.

28th July 2022

R/V Tiger Lily VI departed Mylor at 07:20 on the 28/07/2022 with one independent skipper, the principal scientific officer and one scientific officer. The vessel arrived on site within Gerrans Bay at 07:50 and a CTD drop was carried out at 07:56. A total of 13 survey lines were completed within Gerrans Bay (T158 to T170). Survey operations in Gerrans Bay were completed by 09:04 and the vessel transited to St.Austell Bay to continue surveying. R/V Tiger Lily VI departed the survey site at 16:17 and arrived alongside Mylor at 16:35.

6 Acoustic Data acquisition

Acoustic imagery was acquired at one seagrass bed within Gerrans Bay. A summary of the data collected can be found in Table 2. A total of 170 lines were completed, all of which were included in the analysis.

Table 2: MX line metadata for the 2022 survey of the seagrass within Gerrans Bay

Seagrass bed	Number of lines	Number of lines included in data analysis	Reason why discounted
Gerrans Bay	170	170	N/A

For vessel and equipment specifications see Appendix 1. The daily logs are available on request.

The MX lines completed are shown in Figure 1. The different blue colouring of the lines denotes the orientation of the data capture, i.e. either towards the shore or away from the shore.

6.1 Gerrans Bay

Figure 1: Acoustic survey lines completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022.

7 Data analysis

All lines for each bed were loaded into Biosonics' Visual Aquatic software in a batch, then analysed individually. The threshold for the bottom line, plant line as well as the plant length detection criteria (cm) were analysed for each line in the bed using the same settings (Table 3).

Table 3: Threshold settings for Visual Aquatic and the plant length detection criteria (cm) for each seagrass bed surveyed by Cornwall IFCA

Seagrass bed	Rising edge threshold Db (bottom line)	Plant detection threshold dB (plant line)	Plant detection length criterion (cm)
Gerrans Bay	-40	-60	10

An example of the bottom line (orange) and plant line (green) in areas of varying seagrass collected within Gerrans Bay can be seen in Figure 2.

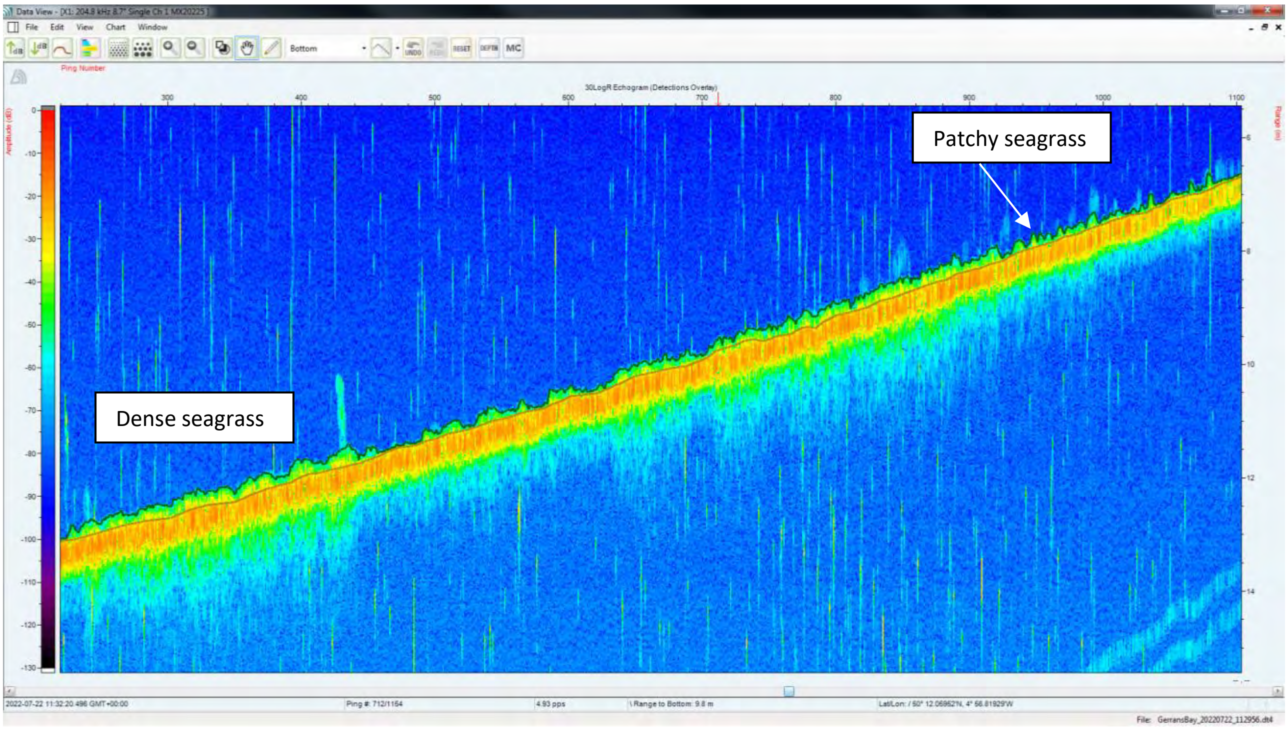


Figure 2: Bottom line (orange) and Plant line (green) in Visual Aquatic by Biosonics software in a dense seagrass bed and patchy seagrass within Gerrans Bay.

Quality assurance (QA) was carried out for tows individually and the bottom line and plant line were manually adjusted where there were errors. The plant line was adjusted when anything other than seagrass was present such as algae, noise in the water column when the vessel was turning and fish in the water column.

Once each line was corrected, the post processing information was recorded in the survey log. The analysed data were exported from Visual Aquatic as a .csv file. Each data point in the .csv file represented the average values of ten consecutive acoustic pings. The data was copied to Microsoft Excel pasted to columns with corrected headers including latitude, longitude, date, time and notes. This was saved as a .xls file and imported into MapInfo Professional Advanced (Version 17.0.4) to create points.

A theme was added to the points data for the plant height (m) and the plant coverage (%). A polygon was drawn around each survey area clipped to the point at the start and end of each tow. A raster was created using the natural neighbour function for plant height (m) and plant coverage (%). The settings for the raster were distance: 20 m, smoothing: 0, clipped to polygon for each survey area, cell size: user suggested and interpolated along edges. Advanced colour was used to define the colour scales.

Plots for points of plant height (m), percentage cover (%) of seagrass, contour plot of plant height (m) and the contour plot of percentage cover of seagrass (%) are shown in Figure 3 to Figure 6.

7.1 Gerrans Bay

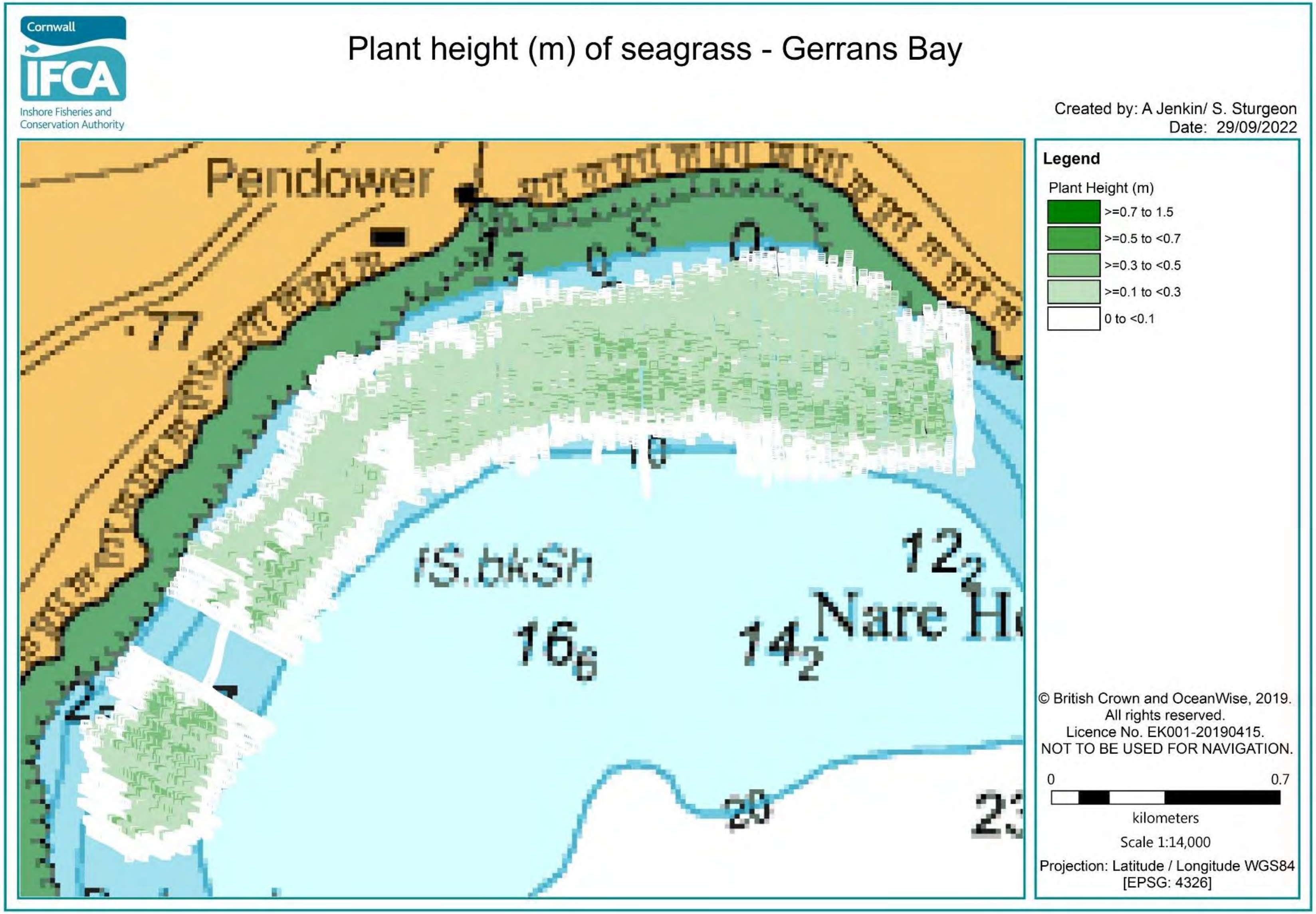


Figure 3: Plant height (m) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

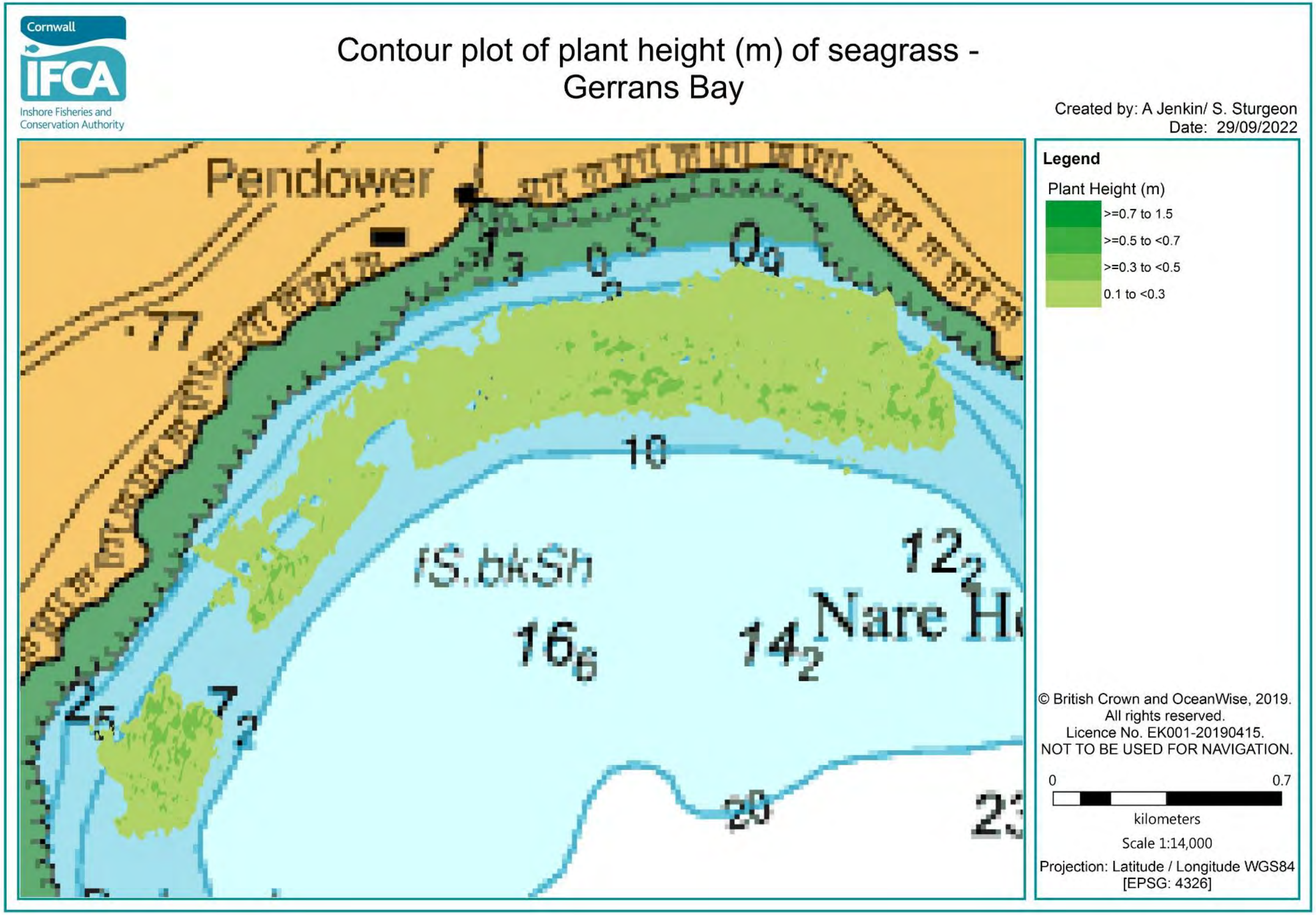


Figure 4: Contour plot displaying plant height (m) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

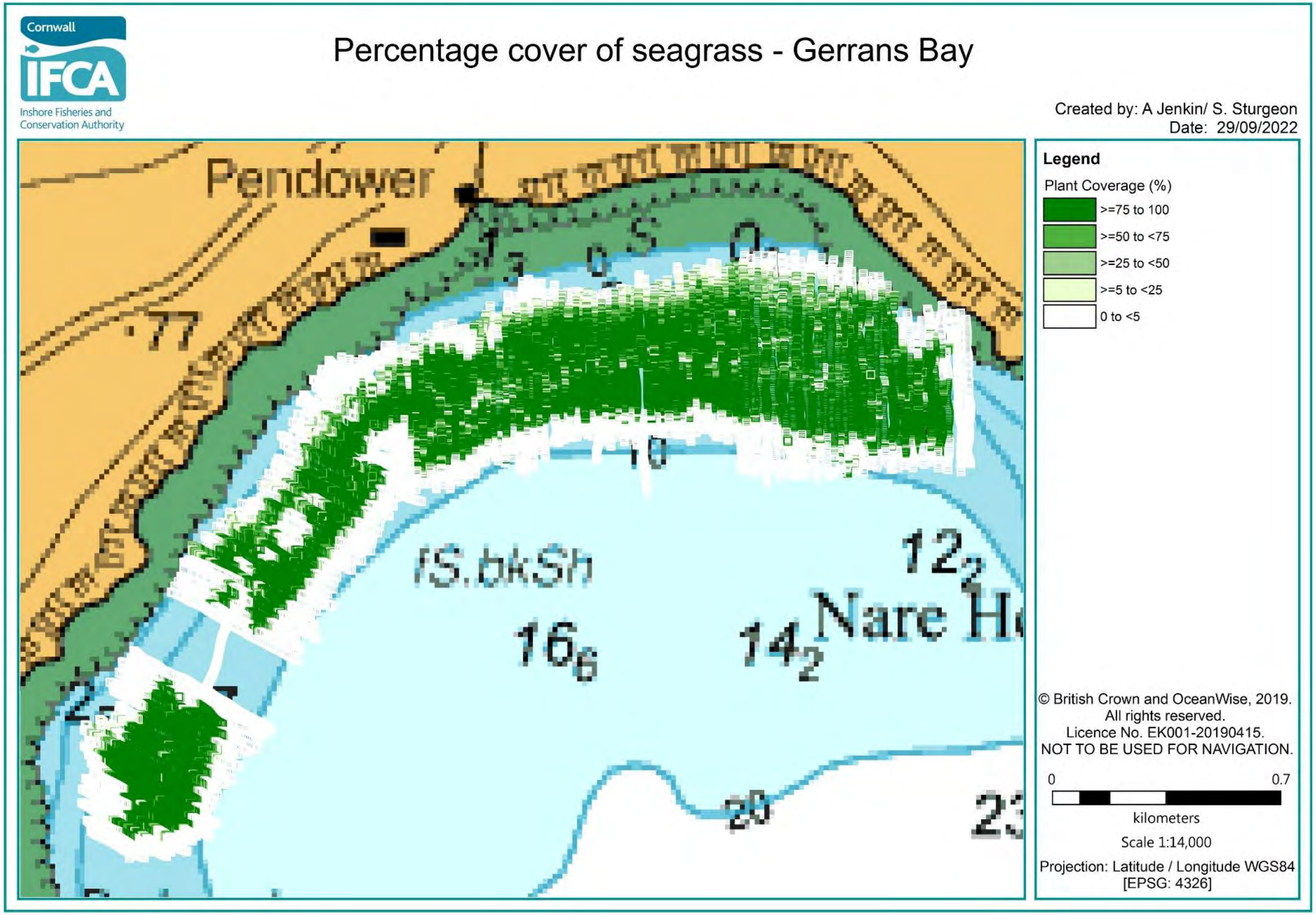


Figure 5: Plant coverage (%) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

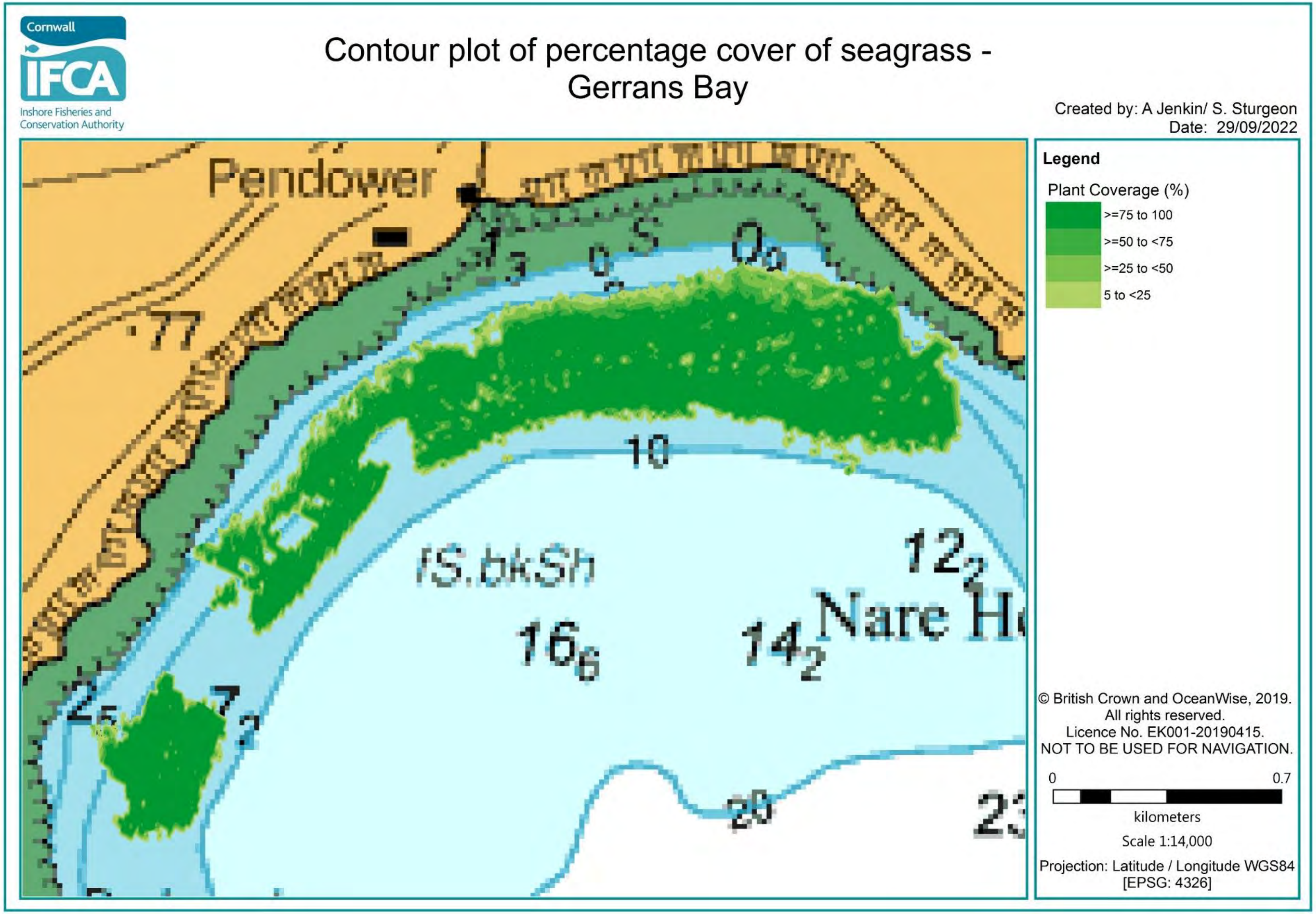


Figure 6: Contour plot displaying plant coverage (%) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

7.2 Area (ha) of seagrass surveyed

The area (ha) of plant coverage >=5% to 100% was calculated by converting the raster from the percentage coverage using the polygonise tool in MapInfo Professional Advanced (Version 17.0.4) to draw a polygon displaying seagrass coverage from >=5 to 100%.

The area (ha) of plant coverage >5% the Gerrans Bay seagrass bed is shown in Table 4.

Table 4: The area (ha) of seagrass >=5% to 100% plant coverage within Gerrans Bay as surveyed by Cornwall IFCA 2022

Seagrass bed	Area (ha) of seagrass >=5% to 100% plant coverage
Gerrans Bay	103.8

8 Discussion

The 2022 survey provided an updated extent, plant height (cm) and estimated plant coverage (%) of the seagrass bed within Gerrans Bay. The total extent of the seagrass (>=5% to 100%) within Gerrans Bay (ha) was calculated as 103.8 ha.

9 Limitations

There were a number of limitations to the survey which included;

- The plant height (m) should not be taken as the absolute plant height as sea grass fronds are generally unable to stand vertical in the water column. This increased with frond length.
- The landward extent of some seagrass beds may not be fully mapped as the draught of the vessel limited how shallow the vessel can operate.
- If the vessel rolls due to increased sea state or the passing of another vessels wake, it can cause similar 'waves' in the data as the Biosonics MX does not have any motion stabilisation. Data that has been subjected to excess rolling can present difficulties in accurately determining if seagrass is present.

10 Recommendations

Ideally the survey would run concurrently with a drop-down video survey with positions set out in a gridded system to verify the acoustic signature at frequent intervals. However, this would increase the time resource required to replicate these surveys at this data capture resolution.

11 References

Environment Agency, 2019. Subtidal seagrass monitoring for the Water Framework Directive (WFD).

Green, B. 2021. Gerrans Bay Subtidal Seagrass Survey 2021. Coastal and Estuarine Assessment, Environment Agency. Unpublished.

Jenkin A., Street, K, Matthews R., Trundle C and Naylor, H. Verifying acoustic signals for habitat classification within St.Austell Bay, Veryan Bay and Gerrans Bay. 2016 Summary Report. Cornwall Inshore Fisheries and Conservation Authority.

MagicMap, 2022. Defra Magic Map Application. Available from: https://magic.defra.gov.uk/magicmap.aspx [Accessed 19/07/2022]

Visual Aquatic, 2022. Post-processing and data visualisation software for Biosonics echosounder systems.

Visual Acquisition MX, 2022. Real-time data acquisition and playback software for Biosonics MX Echsounder Systems.

12 Appendices

Appendix 1 - R/V Tiger Lily VI Deck Plan, Positioning Software Offsets and Equipment Specification

The survey was undertaken from Cornwall IFCA's Research Vessel (R/V) Tiger Lily VI (Annex Figure A). Tiger Lily VI is an MCA coded Cat 2 vessel. The vessel has been refitted for survey work and includes a purpose built survey station within the wheelhouse. R/V Tiger Lily VI has been fitted with an inverter and uninterruptable power supply (UPS) to provide stable, continuous 240 v power, NMEA outputs and a dedicated GPS with WAAS enabled. All times are recorded as UTC and taken from the same source as the position data. The clocks on all of the data capture PCs were synched prior to departing the vessel's mooring.

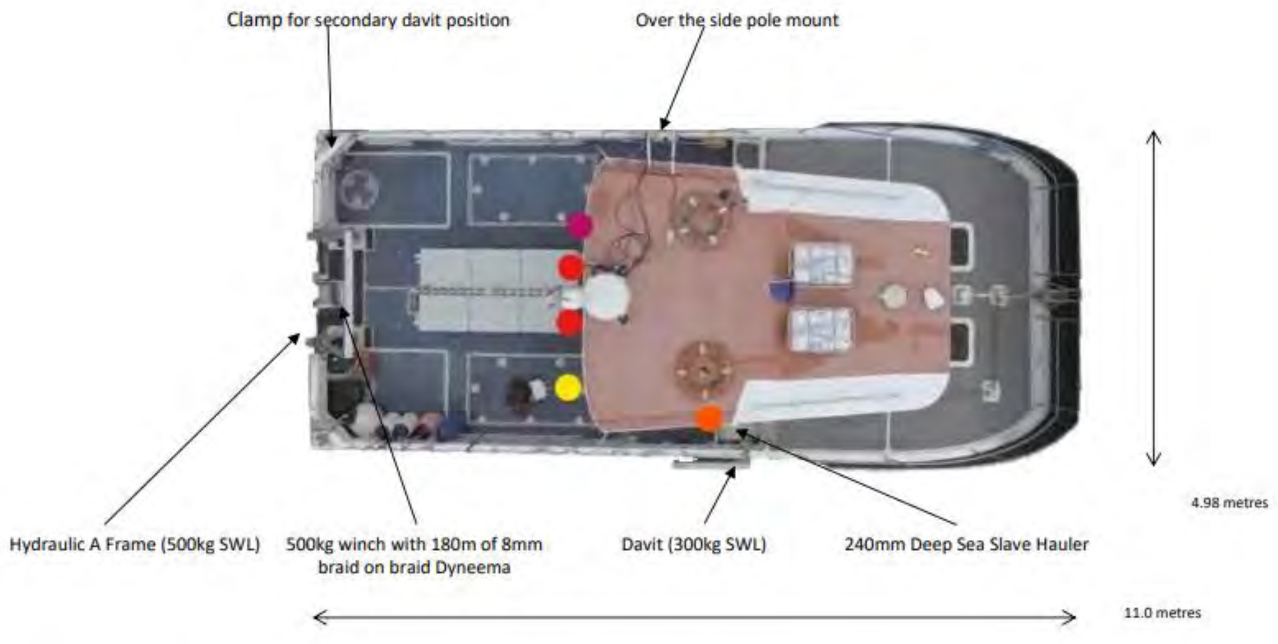
Annex Figure A: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

Annex Table A: Specification of R/V Tiger Lily

Builder	South Boats Ltd
Model	Island MkII
Built	2007
LOA	11.0m
Beam	4.98m
Draught	1.1m (aft)
Tonnage	c.10 tonnes
Area of operation	MCA Category 2
Call sign	MRWR7
MMSI Number	235054954
MECAL Certification number	M07WB0111059
Complement	14 (including min 2 crew)
Propulsion	2 x 450hp Iveco NEF series
Speed	Cruising: 16 – 18 knots Top: 24 – 26 knots
Range	c. 400 nautical miles
240v AC supply	Victron 3Kw power inverter

	5KvA Volvo-Perkins generator (All 240 AC power is accessed via APC Smart UPS C1500)
Stern Gantry	500kg SWL
Winch (on stern gantry)	Spencer Carter 0.5t with scrolling level wind
Slave hauler	Sea Winch 200m dia.
Electric line hauler	12v Spencer Carter Bandit
Positioning	Hemisphere V500 GNSS 3 x Furuno GP32
NMEA data outputs	4 x USB 4 x Serial 4 x banjo
Navigation	Olex with data export Knockle Hypack Max
Connectivity	SATFI 4G Mobile broadband

Positioning Software and Offsets



Annex Figure B: Positioning software and offsets on the deck of R/V Tiger Lily

Annex Table B: Positioning software and offsets onboard R/V Tiger Lily

Equipment				Offset (m)		
NMEA Device	**Plan Symbol**	**Make/Model**	**Offset Name**	**X (Forw'd)**	**Y (Port)**	**Z (+/-)**
Navigation depth sounder	(yellow dot)	Furuno Navnet	Furuno transducer	7.0m	0.75m	- 0.5m
GPS	(red dot)	Furuno GP32 x 2	Furuno mushroom antenna	4.8m	2.1m & 2.35m	+ 3.5m
GPS	(orange dot)	Furuno GP32	Furuno mushroom antenna	3.5m	0.5m	+ 2.0m
GNSS	(magenta dot)	Hemisphere V500	Main GPS	4.8m	3.0m	+ 2.5m

MX Aquatic Habitat Echosounder

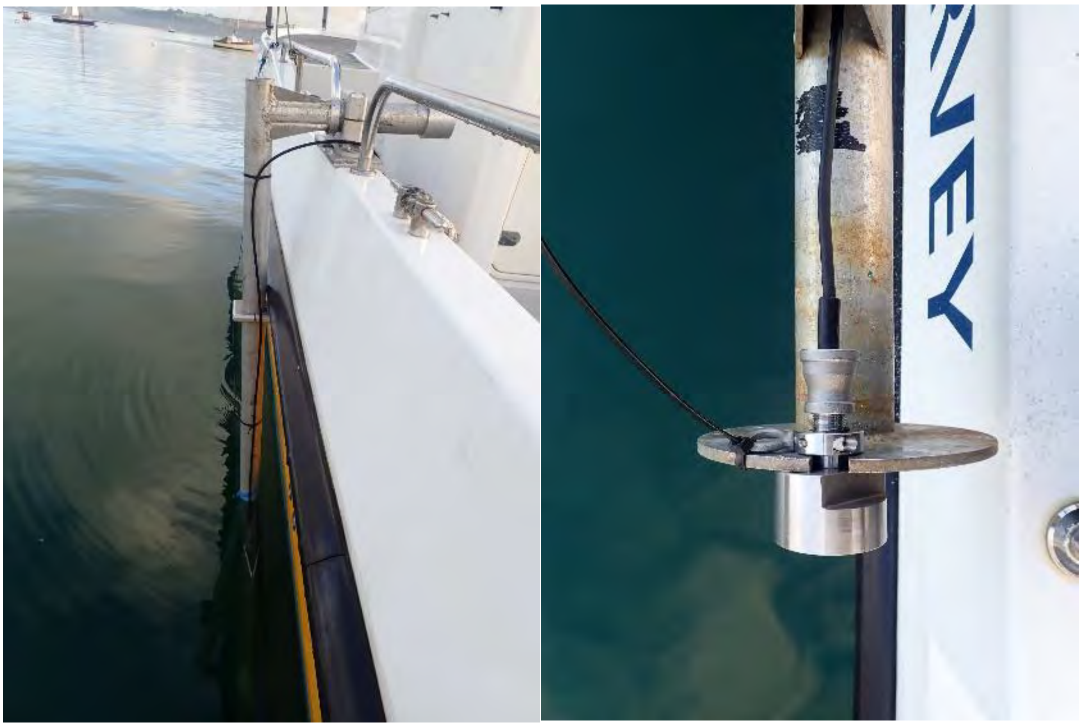
Details of the system are shown in Annex Table C and are available online:

https://www.biosonicsinc.com/wp-content/uploads/2020/09/BioSonics-MX-Spec-Sheet.pdf

Annex Figure C shows the pole mount and MX Acoustic Echosounder on the port side of R/V Tiger Lily VI.

Annex Table C: Equipment specification of the BioSonics MX Aquatic Habitat Echosounder

Specification	Details
Manufacturer	BioSonics
Transducer	Single frequency 204.8kHz Beam angle 8.5 degree conical
Transmit Power	105 Watts RMS
Input power	12-18 VDC or 85-264 VAC
Draw	5 Watts, Fuses: 1 Amp AC 1.5 Amp DC
Transmit source level	213 dB re 1uPa
Pulse length	0.4ms, Ping rate 5Hz
Range resolution	1.7cm
Accuracy	1.7cm +/- 0.2% of depth
Depth range:	0-100m
Operating condition:	0-50 °C
DGPS positional accuracy:	<3m, 95% typical
DGPS velocity accuracy:	0.1 knot RMS
DGPS update rate:	1 sec



Annex Figure C: Pole mount and MX Acoustic Echosounder onboard R/V Tiger Lily VI

Valeport Swift Sound Velocity Profiler

Details of the system are shown in Annex Table D and are available online:

https://www.valeport.co.uk/content/uploads/2022/05/Valeport-SWiFT-CTD-Datasheet.pdf

Annex Table D: Equipment specification of the Valeport Swift Sound Velocity Profiler

Specification	Details
Manufacturer	Valeport
Conductivity	
Range	0-80 mS/cm
Resolution	0.001 m/s
Accuracy	±0.01 m/s
Temperature	
Range	-5°C – +35°C
Resolution	0.001°C
Accuracy	±0.01°C
Pressure	
Range	50 Bar
Resolution	0.001% FS
Accuracy	±0.01% FS

Annex Figure D: Valeport Swift Sound Velocity Profiler deployed from R/V Tiger Lily VI

APPENDIX 3

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Appendix 3 - Example of a blank Seasearch Surveyor Form

SEASEARCH SURVEY FORM

Form No (leave blank) [ ]

seasearch www.seasearch.org.uk

- If anything is unclear please refer to the **Guidance Notes**
- Each pair of divers should complete a form between them
- Please complete all parts of the form. Where there is a * only fill in the information if you know it.

Validated by	Date	Entered by	Date	MR Reference
Recorder leave blank - for Seasearch use				

Your details

Name	Tel No: hm/wk
Address	Email:
	Buddy's Name
	Name of group or survey
Postcode	

Dive/Site details

Site name						Date of dive: dd / mm / yy
General location						Start of dive: : (24hr)
						Dive duration: (mins)
						Sea temperature: °c
Position (degrees and decimal minutes – state if in any other format)						Underwater visibility: m
	Latitude		Longitude		W or E	Drift dive? yes / no
Centre of site	°	.	°	.		Night dive? yes / no
For drift dives From	°	.	°	.		Did you or your buddy take any of the following?
To	°	.	°	.		photographs yes / no
Or OS Grid Reference [ ] [ ]						video footage yes / no
Position derived from: (circle) GPS Chart OS map Web mapping						specimens yes / no
GPS Datum (circle) WGS84 OSGB36						seaweeds for pressing yes / no

Exposure of site: extremely exposed [ ] v exposed [ ] exposed [ ] mod exposed [ ] sheltered [ ] v sheltered [ ] ext sheltered [ ]

Max tidal stream: >6kt [ ] 3-6kt [ ] 1-3kt [ ] <1kt [ ] v. weak [ ]

For the area surveyed, what was

the shallowest depth? (m)	[ ]	bsl	[ ]	bcd
the deepest depth? (m)	[ ]	bsl	[ ]	bcd
Tidal correction to chart datum			[ ]	m*

Seabed summary

Summarise: a. The main features of the site, b. Any unusual features or species, c. Any human activities or impacts at the site

Habitat descriptions

*Complete a box below for each **habitat** you found on your dive. Normally the shallowest habitat is No. 1 even if you have done the dive deepest first. Each written description should tally with the information entered in the columns and diagrams on the next page. If you found more than 3 habitats, continue your descriptions on another form. Tick boxes where shown, and insert percentages (they must add up to 100%) or assign a score from 1-5 as appropriate. If you are uncertain leave the box blank. The biotope code will be assigned later from your description.*

1. DESCRIPTION (physical + community)

Biotope Code

Seabed type: rock ☐ boulders ☐ cobbles ☐ pebbles ☐ gravel ☐ sand ☐ mud ☐ wreckage ☐ other ☐

Communities: kelp forest ☐ kelp park ☐ mixed seaweeds ☐ seagrass bed ☐ enc pink algae ☐

animal turf ☐ animal bed ☐ sediment with life ☐ barren sediment ☐

2. DESCRIPTION (physical + community)

Biotope Code

Seabed type: rock ☐ boulders ☐ cobbles ☐ pebbles ☐ gravel ☐ sand ☐ mud ☐ wreckage ☐ other ☐

Communities: kelp forest ☐ kelp park ☐ mixed seaweeds ☐ seagrass bed ☐ enc pink algae ☐

animal turf ☐ animal bed ☐ sediment with life ☐ barren sediment ☐

3. DESCRIPTION (physical + community)

Biotope Code

Seabed type: rock ☐ boulders ☐ cobbles ☐ pebbles ☐ gravel ☐ sand ☐ mud ☐ wreckage ☐ other ☐

Communities: kelp forest ☐ kelp park ☐ mixed seaweeds ☐ seagrass bed ☐ enc pink algae ☐

animal turf ☐ animal bed ☐ sediment with life ☐ barren sediment ☐

1	2	3	
	m		**DEPTH LIMITS**
			Upper (from sea level) (i.e. minimum)
			Lower (from sea level) (i.e. maximum)
			Upper (from chart datum) *
			Lower (from chart datum) *

	%		**SUBSTRATUM**
			Bedrock type?:
			Boulders - very large > 1.0 m
			- large 0.5 - 1.0 m
			- small 0.25 - 0.5 m
			Cobbles (fist - head size)
			Pebbles (50p - fist size)
			Gravel - stone
			- shell fragments
			Sand - coarse
			- medium
			- fine
			Mud
			Shells (empty - or as large pieces)
			Shells (living - eg mussels, limpets)
			Artificial - metal
			- concrete
			- wood
			Other (state)
100	100	100	**Total**

1	2	3	
	1-5		**FEATURES - ROCK (all categories)**
			Relief of habitat (even - rugged)
			Texture (smooth - pitted)
			Stability (stable - mobile)
			Scour (none - scoured)
			Silt (none - silted)
			Fissures > 10 mm (none - many)
			Crevices < 10 mm (none - many)
			Boulder/cobble/pebble shape (rounded - angular)
			Sediment on rock? (tick if present)

	✓		**FEATURES – SEDIMENT (1)**
			Mounds / casts
			Burrows / holes
			Waves (>10 cm high)
			Ripples (< 10 cm high)
			Subsurface coarse layer?
			Subsurface anoxic (black) layer?

	1-5		**FEATURES – SEDIMENT (2)**
			Firmness (firm - soft)
			Stability (stable - mobile)
			Sorting (well - poor)

Sketches and plans

*Draw a **profile** and/or **plan** of the sea bed you encountered on your dive in the space below. Mark (& number) the different habitats, corresponding to the written descriptions on p.2. Indicate conspicuous and/or characteristic species. Make sure you include **depth(s)** (vertical axis) and a **distance** scale (horizontal axis) for a profile and scale and north point for a plan. Indicate the direction of the profile or plan and the direction of any current.*

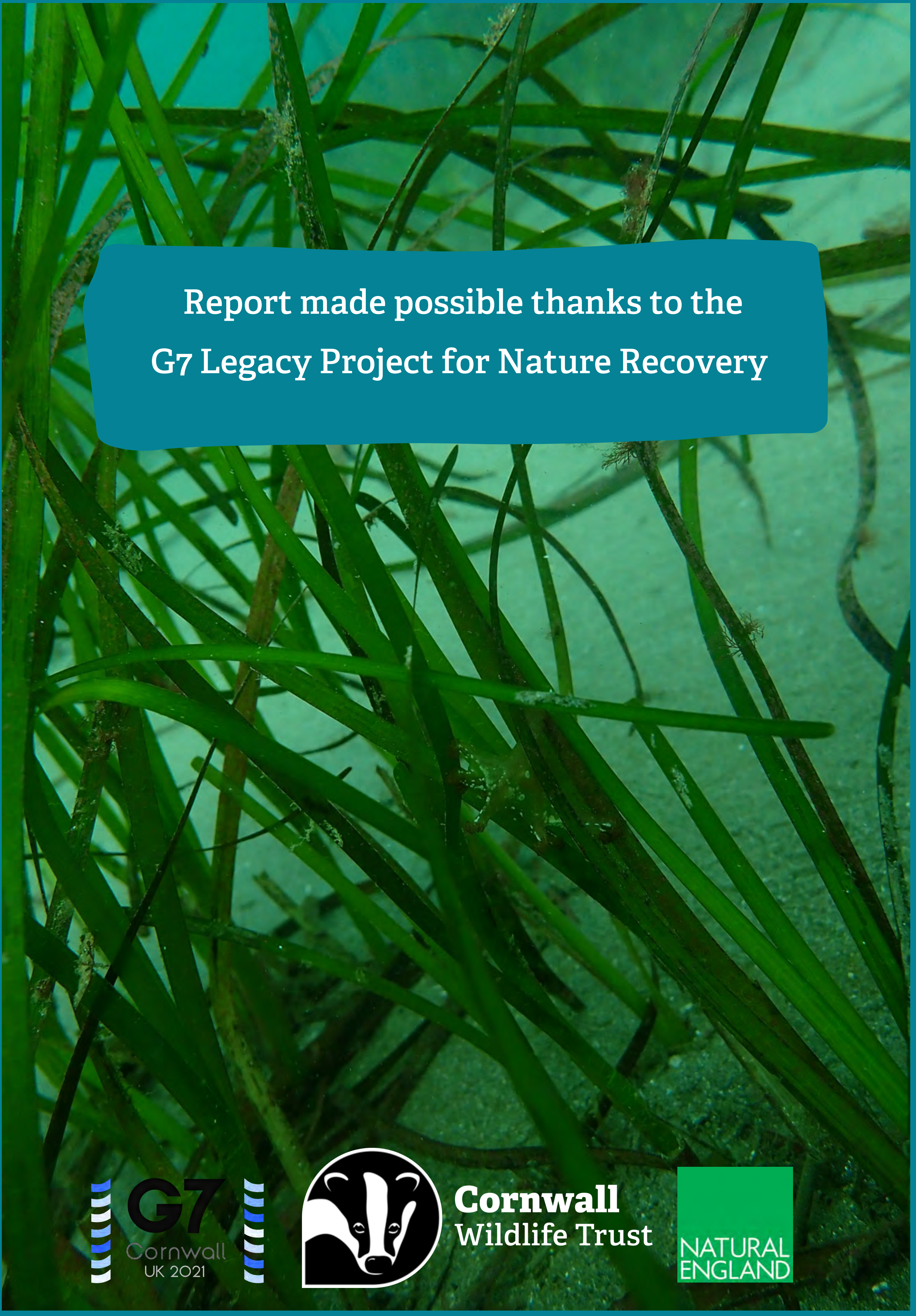
Species List

Score the abundance of each group of animals and plants ***in each habitat*** *alongside the name. In the blank spaces list the seaweeds & animals which you were able to identify* ***positively*** *from the different habitats. Use latin names if possible, but if you don't know them, common or descriptive names are acceptable. If you are not 100% sure about any, add a question mark. Do not enter names as guesses - it's better to exclude them than to include incorrect identifications. Give abundances in the columns: Super abundant, Abundant, Common, Frequent, Occasional & Rare. If you did not note abundances, simply enter a P for Present. Continue on a separate sheet, if necessary. If you have a photograph of the species tick the* ***ph*** *column.*

	ph	1	2	3		ph	1	2	3
sponges					echinoderms				
cnidarians: hydroids, anemones, corals,					sea squirts				
					fishes				
worms									
crustaceans					seaweeds				
molluscs									
					other or continuations				
bryozoans									
					Continue on a separate sheet if you need to				

Once completed return the form to the Dive Organiser or to Seasearch, Marine Conservation Society, Over Ross House, Ross Park, Ross-on-Wye, Herefordshire, HR9 7QQ.

Your contact details will be included on the Seasearch database and those of partner organisations and will be used to send you information about Seasearch and associated projects. They will not be passed to third parties without your consent. The location, dive details, habitats and species information and the name of the recorder will be entered into a database and made available to the participating organisations and the general public through the Seasearch and NBN websites. If you do not agree with this use of the data do not submit the form.



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G7 Cornwall UK 2021

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NATURAL ENGLAND