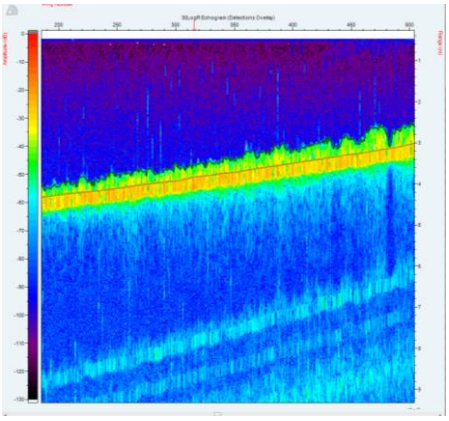
Acoustic Survey of the seagrass bed within St Austell Bay 2022



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

Cited as:

Jenkin, A., Sturgeon S and Trundle, C. 2022. Survey field report for the 2022 acoustic survey of the seagrass bed within St.Austell Bay. Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA), Hayle, on behalf of Cornwall Wildlife Trust and Natural England as part of the G7 Legacy Project for Nature Recovery (G7LPNR).

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

Cornwall IFCA
Office 2
Chi Gallos
Hayle Marine Renewables Business Park
North Quay
Hayle
Cornwall
TR27 4DD

Tel: 01736 336842 Email: enquiries@cornwall-ifca.gov.uk

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, 16thAugust, 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.

Table of Contents

Summary iii

Table of Contents iv

List of Figures v

List of Tables v

List of Annex Figures v

List of Annex Tables v

Glossary of Terms and Abbreviations 1

1 Background and Introduction 2

1.1 Aims & Objectives 2

1.1.1 Aims 2

1.1.2 Objectives 2

1.2 Historic data 2

2 Survey Operations 3

2.1 Personnel 3

2.2 Personal Protective Equipment (PPE) 3

3 Survey Methodology 3

4 Data handling 3

5 Cruise Narrative 4

6 Acoustic Data acquisition 5

6.1 St Austell Bay 7

7 Data analysis 8

7.1 St Austell Bay 10

7.2 Area (ha) of seagrass surveyed 14

8 Discussion 15

9 Limitations 15

10 Recommendations 15

11 References 16

12 Appendices 17

Appendix 1 - R/V Tiger Lily VI Deck Plan, Positioning Software Offsets and Equipment Specification 17

Positioning Software and Offsets 19

MX Aquatic Habitat Echosounder 20

Valeport Swift Sound Velocity Profiler 21

List of Figures

Figure 1: Acoustic survey lines completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022. 7

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. 8

Figure 3: Plant height (m) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022 10

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 11

Figure 5: Plant coverage (%) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022 12

Figure 6: Contour plot displaying plant coverage (%) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022 13

List of Tables

Table 1: Previous surveys of the seagrass within St Austell Bay seagrass 2

Table 2: MX line metadata for the 2022 survey of the seagrass within St Austell Bay.....5

Table 3: Threshold settings for Visual Aquatic and the plant length detection criteria (cm) for each seagrass bed surveyed by Cornwall IFCA.....8

Table 4: The area (ha) of seagrass >=5% to 100% plant coverage within St Austell Bay as surveyed by Cornwall IFCA 2022 14

List of Annex Figures

Annex Figure A: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI. 17

Annex Figure B: Positioning software and offsets on the deck of R/V Tiger Lily 19

Annex Figure C: Pole mount and MX Acoustic Echosounder onboard R/V Tiger Lily VI.....20

Annex Figure D: Valeport Swift Sound Velocity Profiler deployed from R/V Tiger Lily VI 21

List of Annex Tables

Annex Table A: Specification of R/V Tiger Lily 17

Annex Table B: Positioning software and offsets onboard R/V Tiger Lily.....19

Annex Table C: Equipment specification of the BioSonics MX Aquatic Habitat Echosounder 20

Annex Table D: Equipment specification of the Valeport Swift Sound Velocity Profiler 21

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

CIFCA_2022_Acoustic Survey of the seagrass bed within St Austell Bay

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.

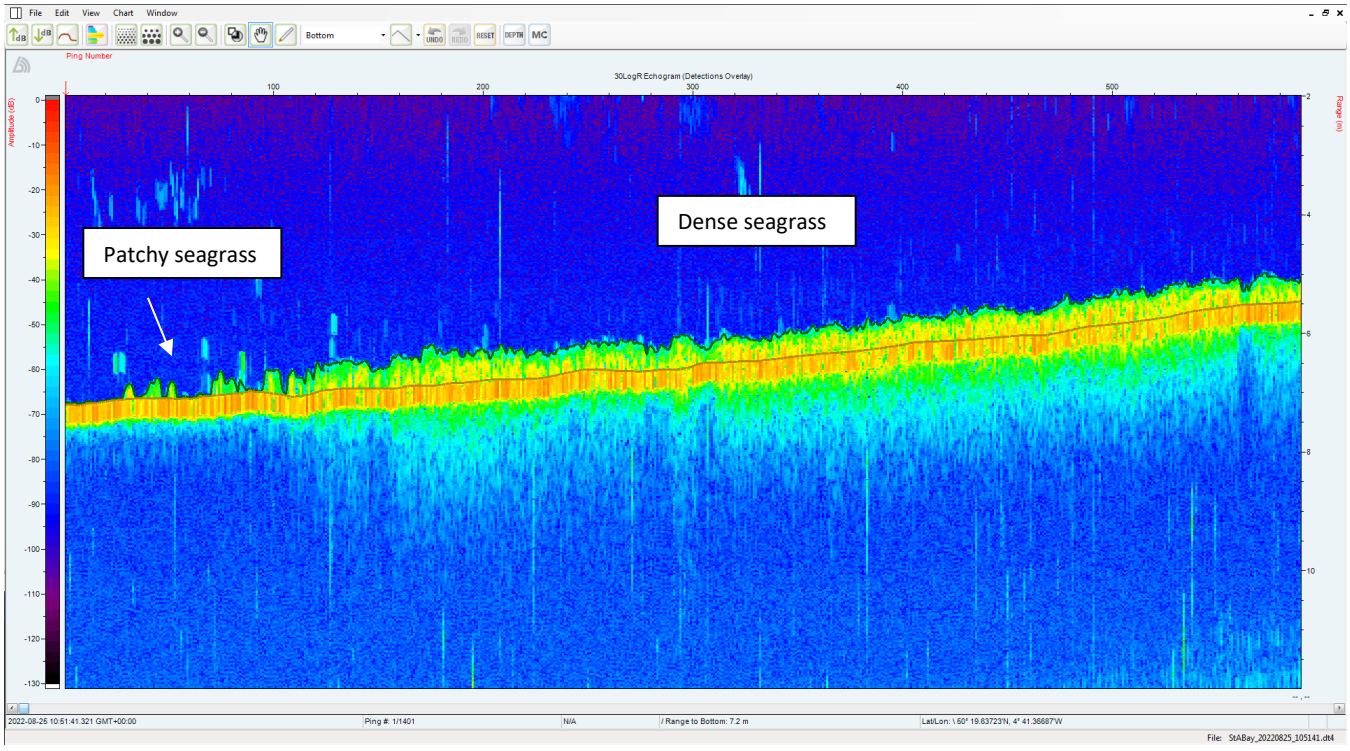


Figure 2: Bottom line (orange) and Plant line (green) in Visual Aquatic by Biosonics software in a dense seagrass bed and patchy seagrass within St Austell Bay.

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: 30 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

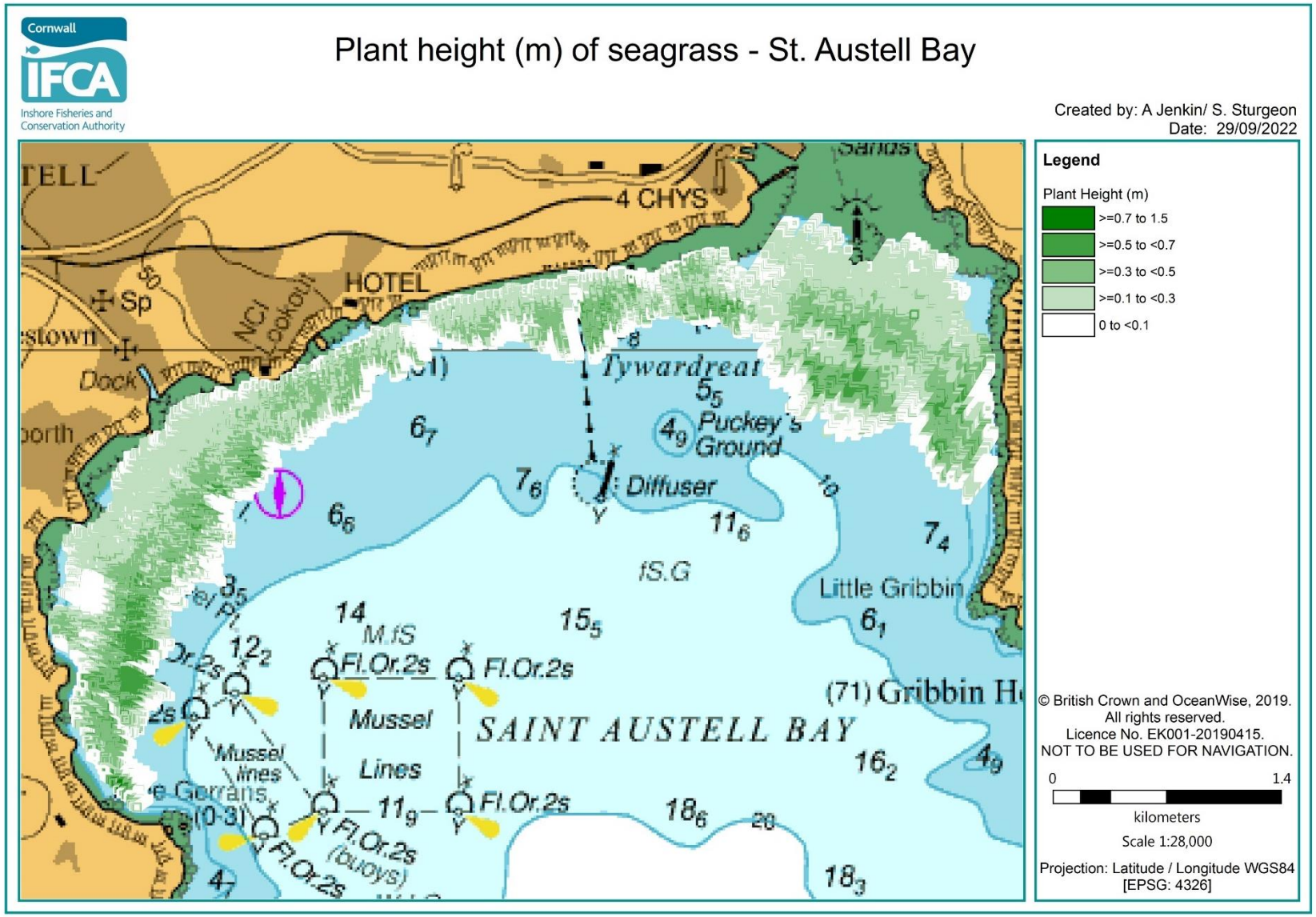


Figure 3: Plant height (m) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

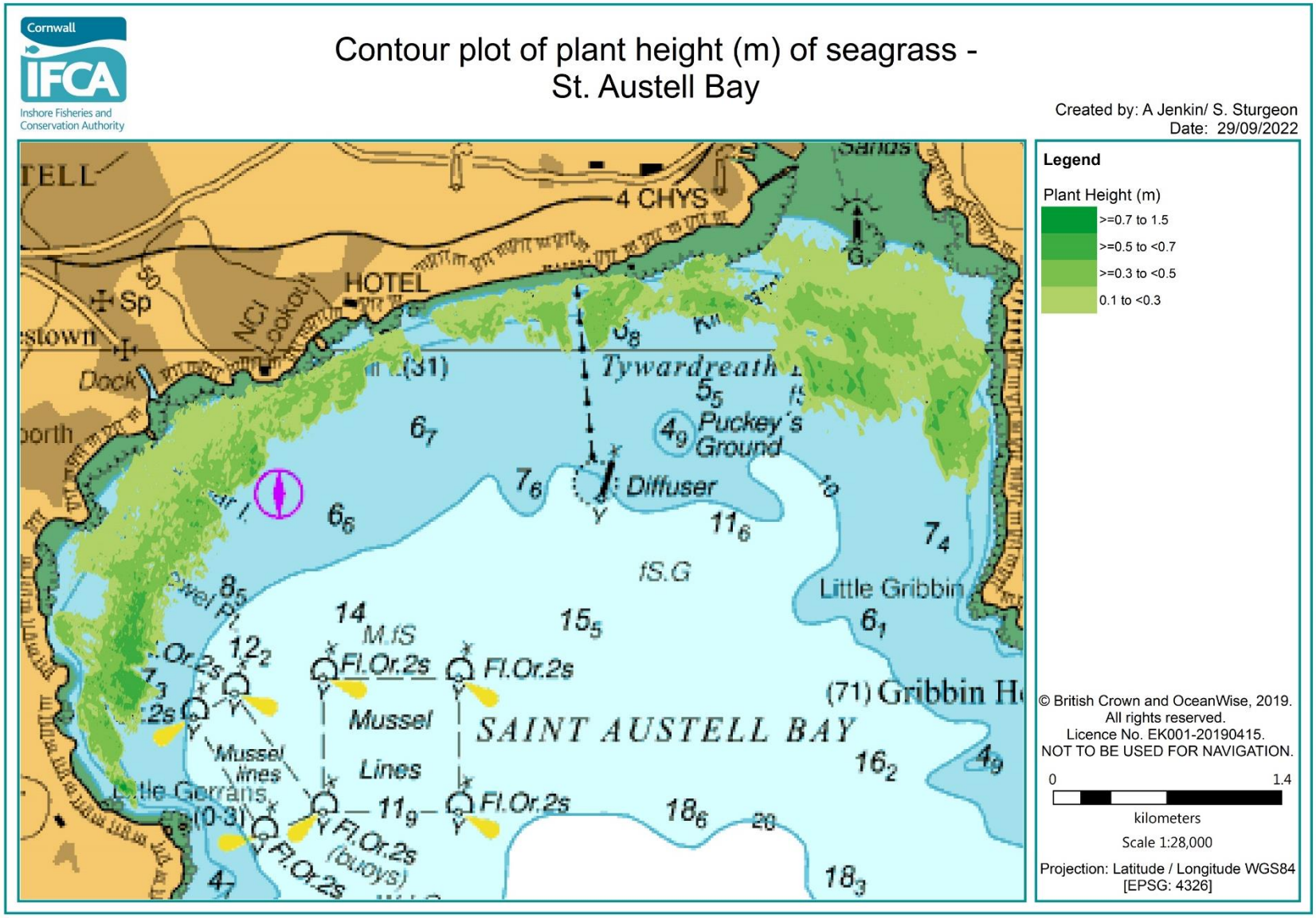


Figure 4: Contour plot displaying plant height (m) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

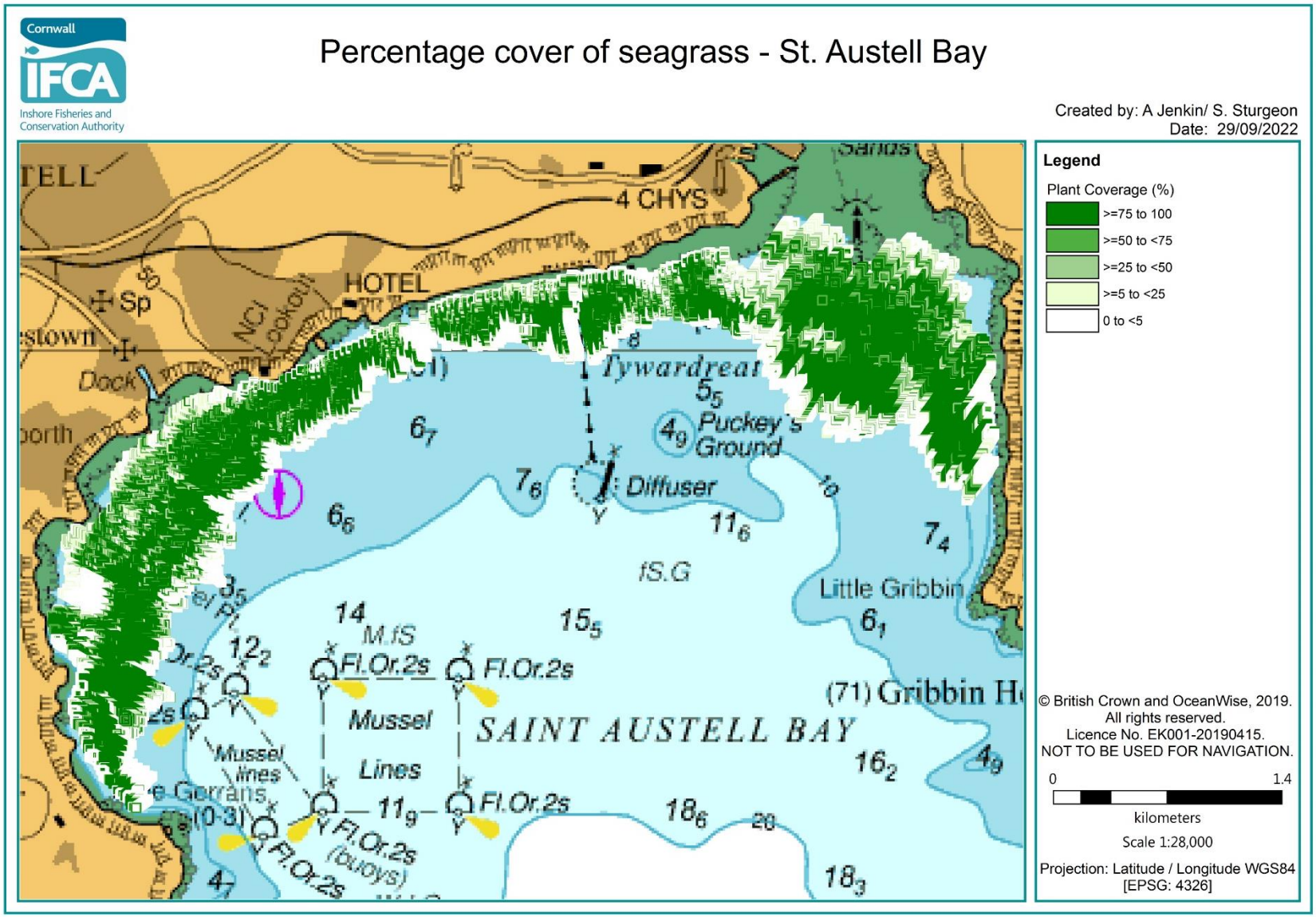


Figure 5: Plant coverage (%) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

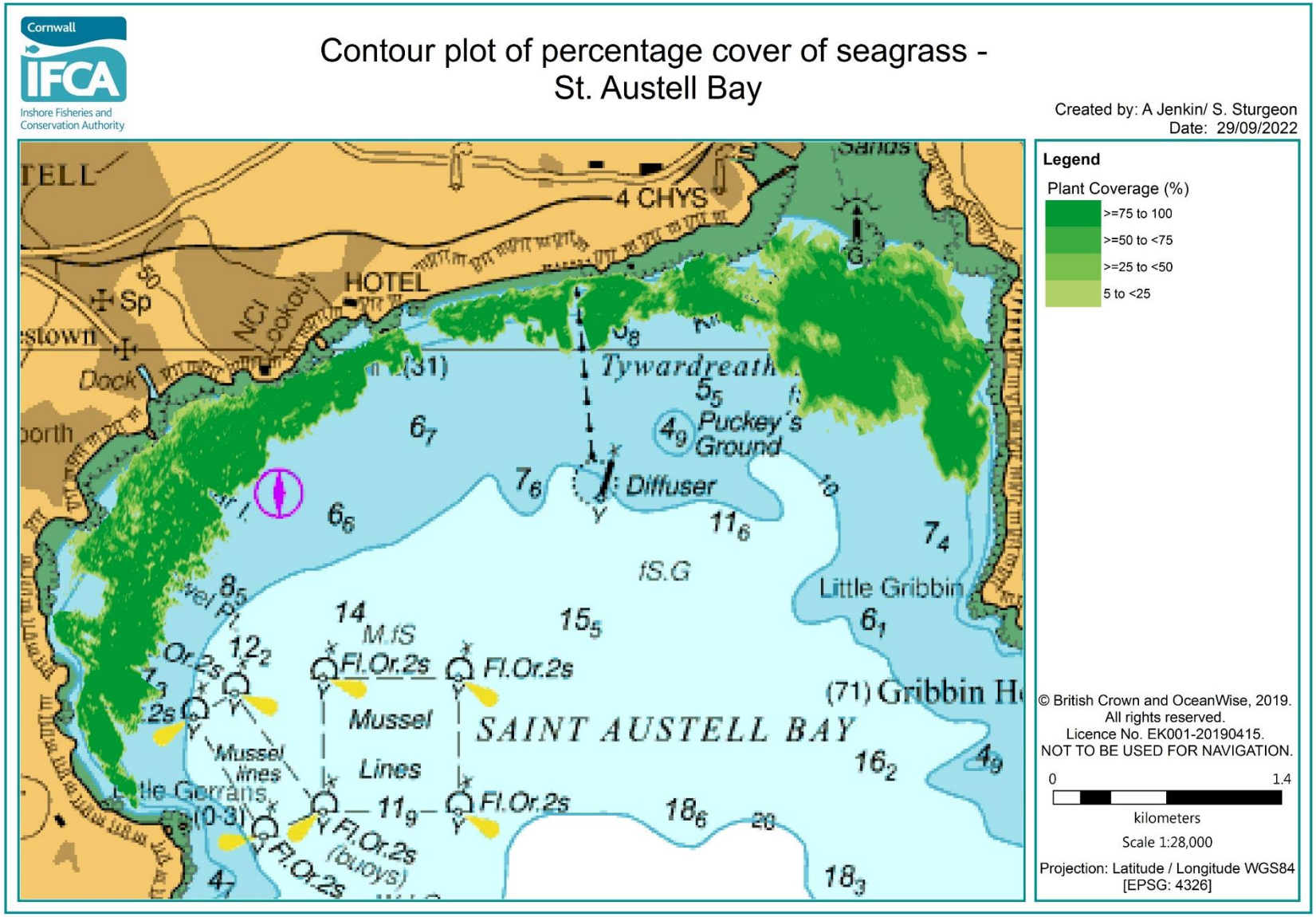


Figure 6: Contour plot displaying plant coverage (%) of seagrass (*Zostera marina*) completed within St Austell Bay using an MX Echosounder by Cornwall IFCA 2022

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.

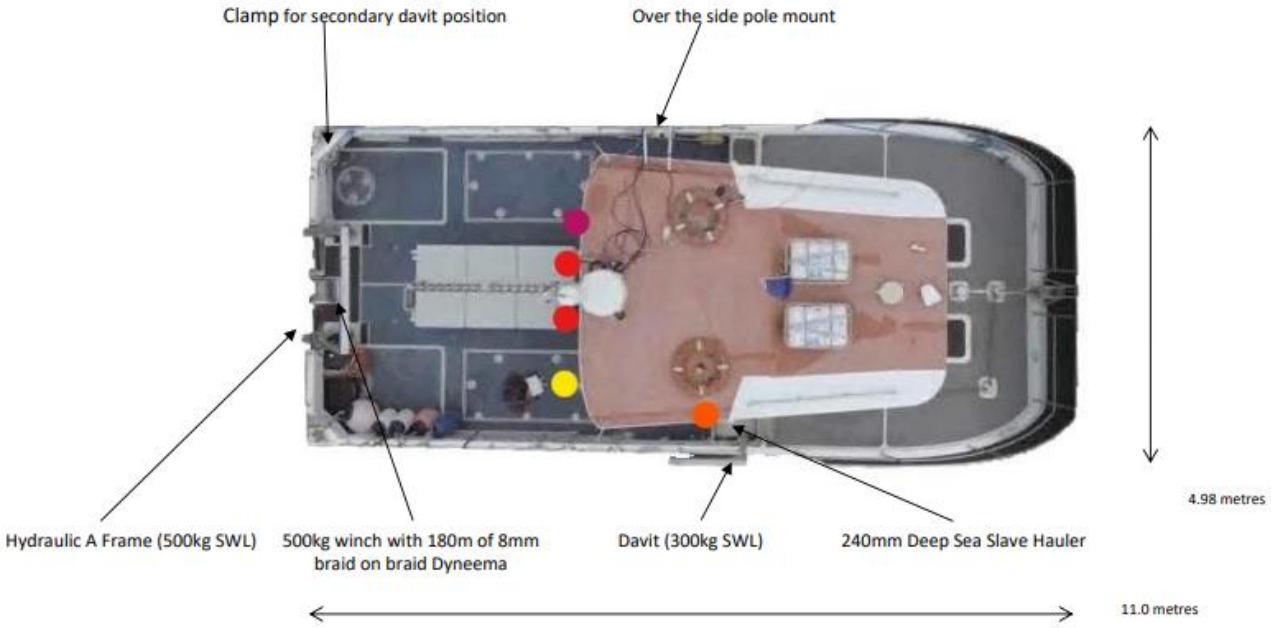
Annex Figure A: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

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

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		Furuno Navnet	Furuno transducer	7.0m	0.75m	- 0.5m
GPS		Furuno GP32 x 2	Furuno mushroom antenna	4.8m	2.1m & 2.35m	+ 3.5m
GPS		Furuno GP32	Furuno mushroom antenna	3.5m	0.5m	+ 2.0m
GNSS		Hemisphere V500	Main GPS	4.8m	3.0m	+ 2.5m

MX Aquatic Habitat Echosounder

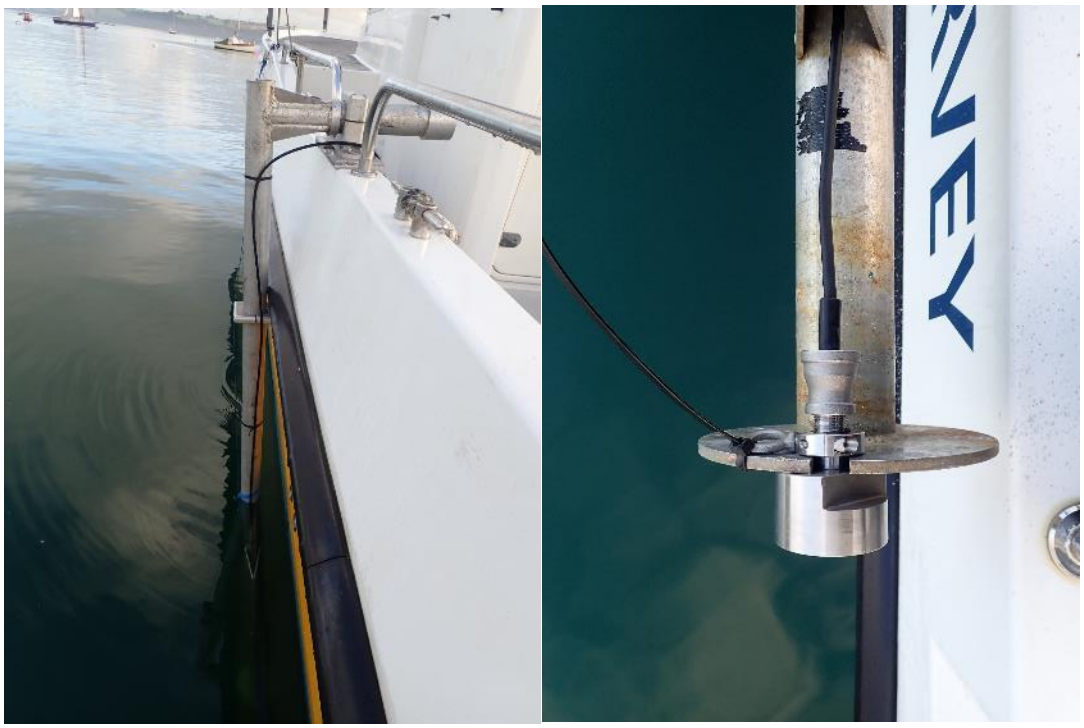
Details of the system are shown in Annex Table C and are available online:

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