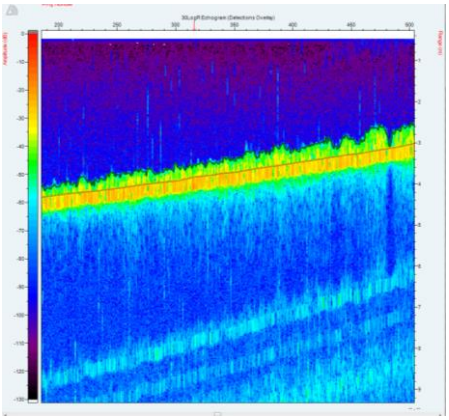
Acoustic Survey of the seagrass bed at Cawsand within the Plymouth Sound and Estuaries Special Area of Conservation 2021



Survey field report for the 2021 Acoustic Survey of the seagrass bed at Cawsand within the Plymouth Sound and Estuaries Special Area of Conservation

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Authors	**Date**	**Comment**	**Version**
A Jenkin	06/09/2021	First draft	0.1
S Sturgeon and C Trundle	27/09/2021	QA	0.2
A Jenkin	05/10/2021	QA comment amendments	Final

Summary

This report summarises the operations and data acquired during the 2021 acoustic survey of the seagrass bed at Cawsand within the Plymouth Sound and Estuaries Special Area of Conservation (SAC). The survey was carried out over one day, 23rd August 2021.

The aim of the survey was to map the extent and coverage of the seagrass bed at Cawsand within the Plymouth Sound and Estuaries SAC using a Biosonics MX Scientific Echosounder. In total 64 MX tows were completed of which 62 were included in the analysis. Sea conditions were favourable throughout the survey.

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Glossary of Terms and Abbreviations

CTD – Conductivity, Temperature, and Depth

EOL – End of Line

IFCA - Inshore Fisheries and Conservation Authority

SAC – Special Area of Conservation

SOL – Start of Line

1 Background and Introduction

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA) carried out a survey to map the extent of the seagrass at Cawsand, within the Plymouth Sound and Estuaries Special Area of Conservation (SAC). The survey was carried out to provide Cornwall IFCA with an updated extent map of the seagrass. The seagrass at Cawsand is the only bed in the Plymouth Sound and Estuaries SAC which is within the Cornwall IFCA district, the remaining seagrass beds (Drake's Island, Cellar's Cove, Red Cove North, Red Cove South, Tomb Rock, Jennycliff South, Jennycliff North and Firestone Bay) are within the Devon and Severn IFCA district.

1.1 Aims & Objectives

1.1.1 Aims

- Map the extent of the seagrass bed at Cawsand within the Plymouth Sound and Estuaries SAC.

1.1.2 Objectives

- Collate database of all known extents of seagrass at Cawsand within the Plymouth Sound and Estuaries SAC.
- 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 (%).

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 Appendix 1. Survey operations and protocols are described below.

2.1 Personnel

All survey days consisted of one Scientific Officer and an independent skipper onboard and two scientific officers working remotely from home due to Coronavirus (COVID-19).

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. Hard hats were worn during deployment and recovery of the pole. There were no reported accidents or near misses throughout the survey.

3 Survey Methodology

Historic survey data of seagrass at Cawsand within the Plymouth Sound and Estuaries SAC were downloaded using the latest marine data release provided by Natural England and EMODnet and a 40 m buffer was created around each bed. These positions 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 echosounder simultaneously acquires submerged aquatic vegetation (including seagrass), substrate and bathymetry data using Visual Acquisition by BioSonics (Version 6.4) software. The transducer was deployed over the port side of the vessel via a pole mounted on the side which can be deployed for survey operations.

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

Remote access software was used on all laptops to enable the home based scientific officers to independently operate the MX Echosounder controls and HYPACK. Microsoft Teams was also used throughout each survey day to enable the home-based officers to maintain continuous communication with the survey crew aboard the vessel.

On arrival at Cawsand, 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. 20210823_113700.

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).

23rd August 2021

R/V Tiger Lily VI departed Mylor at 07:23 on the 23/08/2021 with one Scientific Officer and an independent skipper on board. Two scientific officers worked remotely. The vessel arrived on site at Cawsand at 11:05 after having carried out visual inspections of the FISH INTEL project acoustic receivers *en route*. A CTD drop was carried out at 11:24. A total of 64 MX tows were completed at Cawsand.

R/V Tiger Lily VI arrived alongside Mylor at 20:47.

6 Acoustic Data acquisition

Acoustic imagery was acquired at one seagrass bed within the Plymouth Sound and Estuaries SAC. A summary of the data collected can be found in Table 1. A total of 64 lines were completed and a total of 62 lines were included in the data analysis.

Table 1: MX line metadata for the 2021 survey of the seagrass within the Plymouth Sound and Estuaries Special Area of Conservation

Seagrass bed	Number of lines	Number of lines included in data analysis	Reason why discounted
Cawsand	64	62	One line was recorded before the start of the survey when testing the equipment and another was recorded accidentally

For vessel specifications see Appendix 1, equipment specification see Appendix 2. 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 Cawsand

Figure 1: Acoustic survey lines completed at Cawsand using an MX Echosounder by Cornwall IFCA 2021.

7 Data analysis

All lines for each bed were loaded into Visual Aquatic by BioSonics 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 2).

Table 2: 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)
Cawsand	-40	-60	10

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

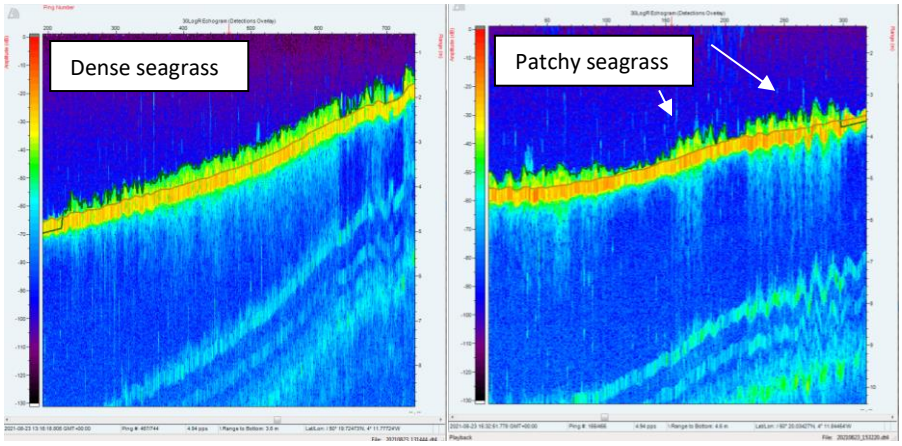


Figure 2: Bottom line (orange) and Plant line (green) in Visual Aquatic by Biosonics software in a dense seagrass bed and patchy seagrass at Cawsand.

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 which records the data as an average of every ten 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 Cawsand

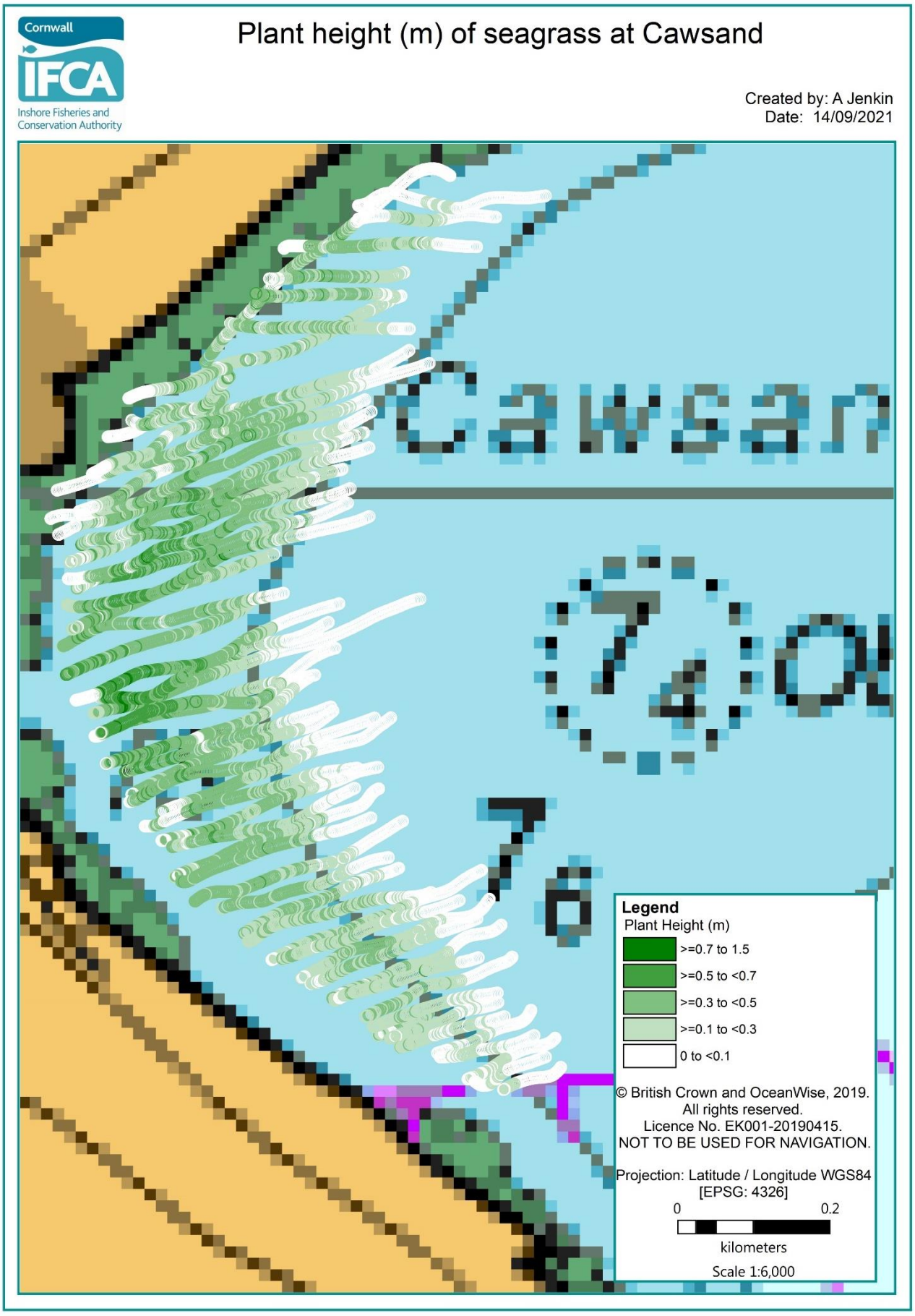


Figure 3: Plant height (m) of seagrass (*Zostera marina*) completed at Cawsand using an MX Echosounder by Cornwall IFCA 2021

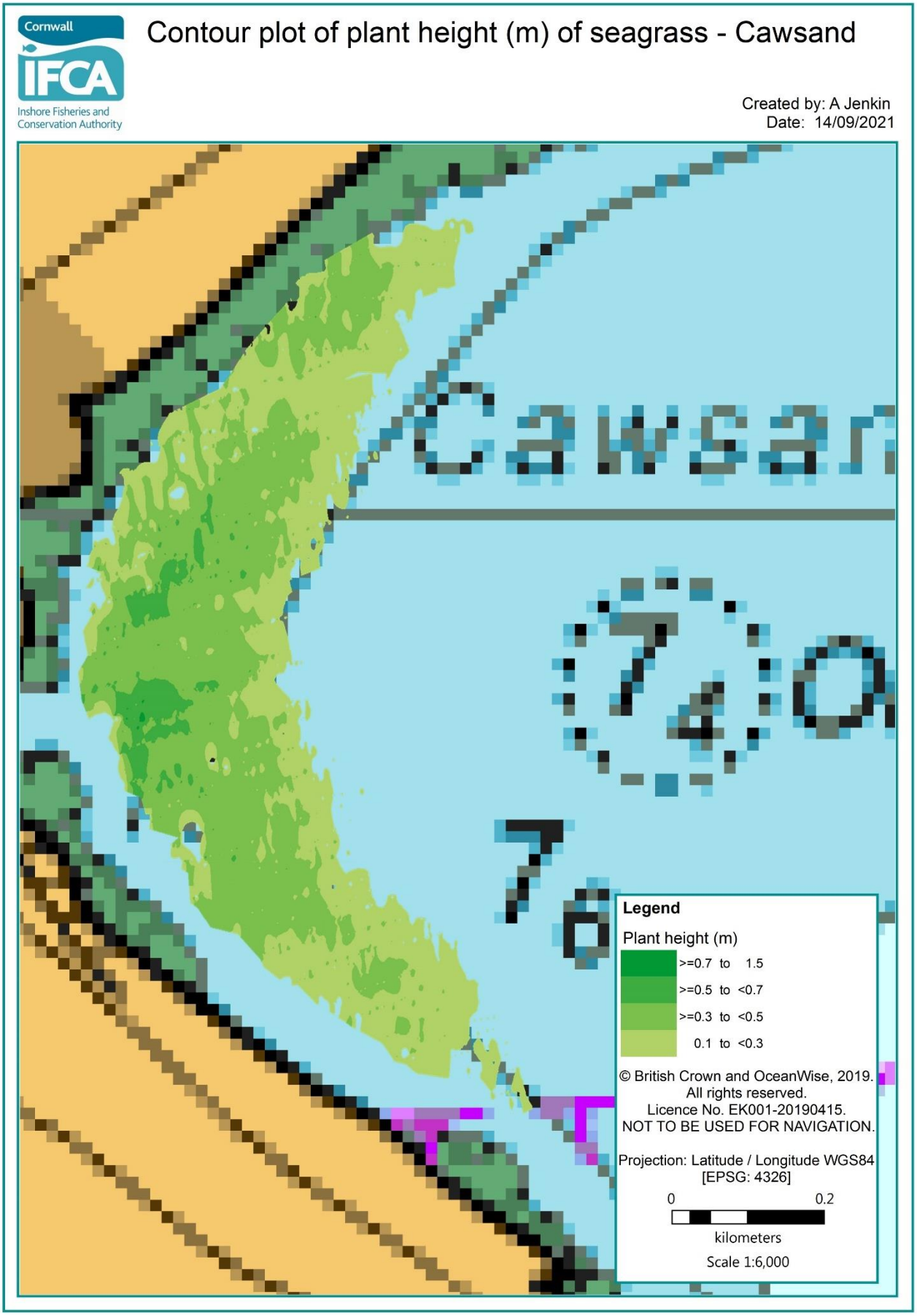


Figure 4: Contour plot displaying plant height (m) of seagrass (*Zostera marina*) completed at Cawsand using an MX Echosounder by Cornwall IFCA 2021

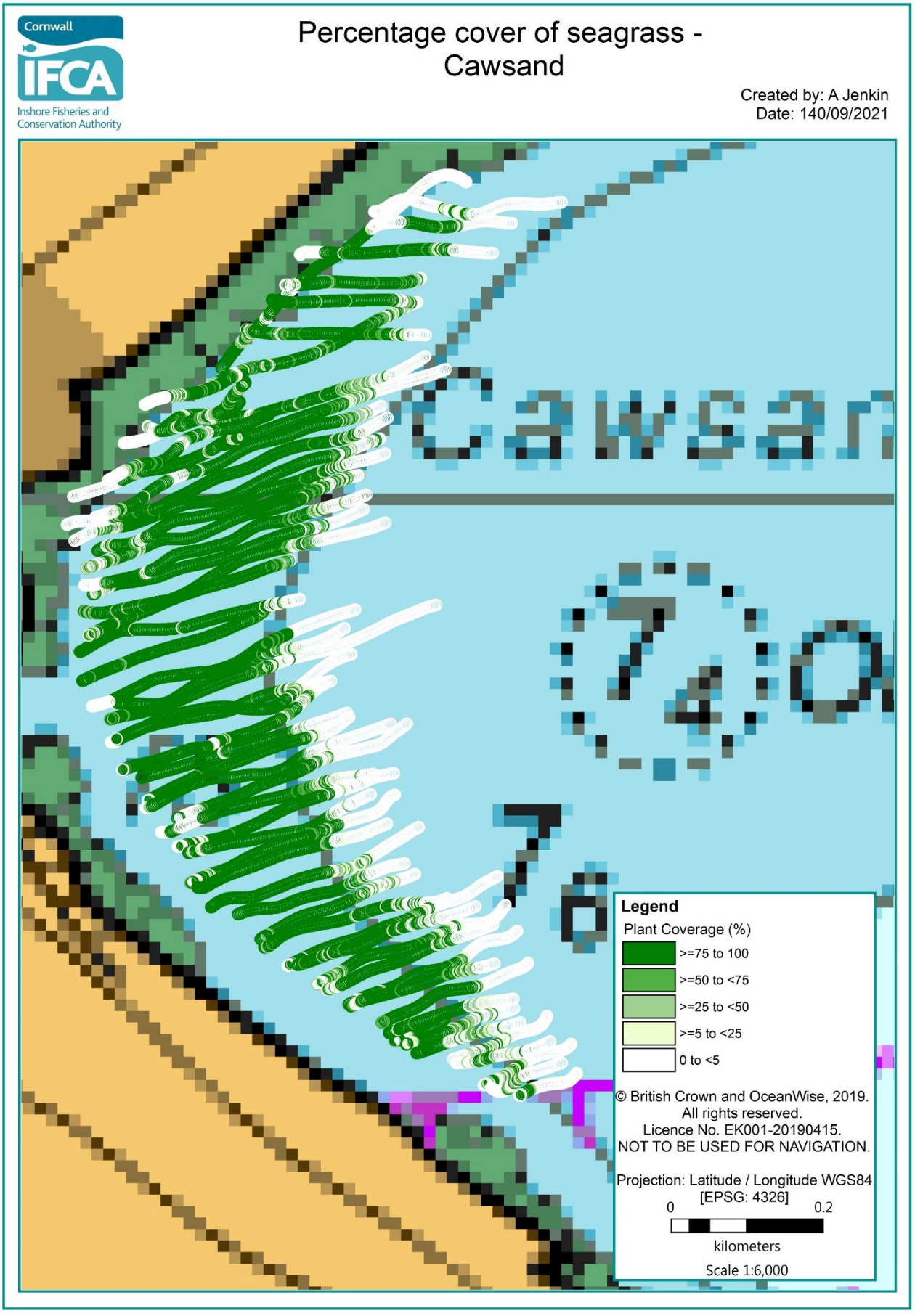


Figure 5: Plant coverage (%) of seagrass (*Zostera marina*) completed at Cawsand using an MX Echosounder by Cornwall IFCA 2021

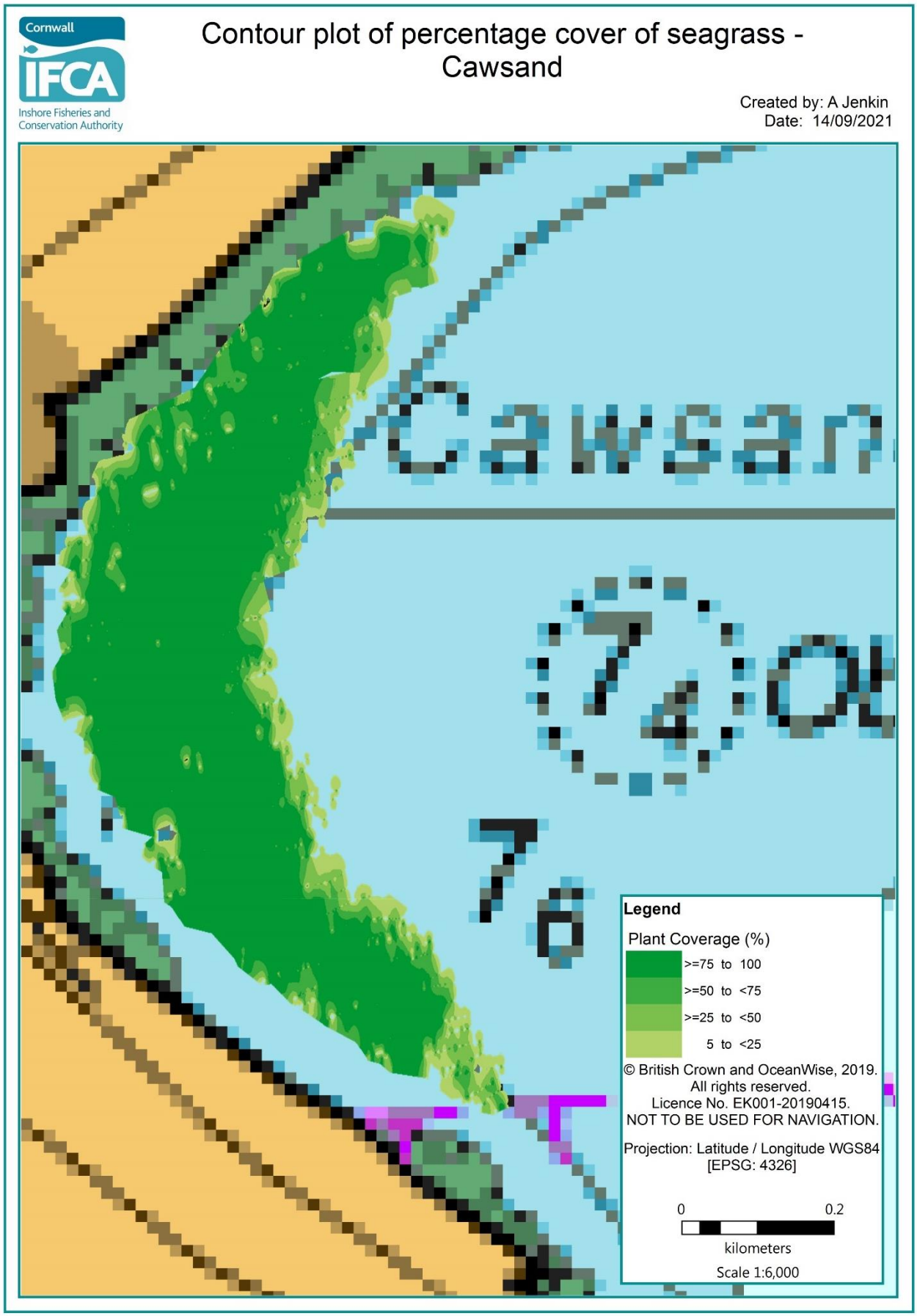


Figure 6: Contour plot displaying plant coverage (%) of seagrass (*Zostera marina*) completed at Cawsand using an MX Echosounder by Cornwall IFCA 2021

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 Cawsand seagrass bed is shown in Table 3.

Table 3: The area (ha) of seagrass >=5% to 100% plant coverage at Cawsand as surveyed by Cornwall IFCA 2021

Seagrass bed	Area (ha) of seagrass >=5% to 100% plant coverage
Cawsand	28.67

8 Discussion

The 2021 survey of the Plymouth Sound and Estuaries SAC seagrass provided an updated extent and plant height (cm) and plant coverage (%) of the seagrass bed at Cawsand.

During the survey it was observed by Cornwall IFCA officers that 28 vessels were anchored on the seagrass bed on the day the survey took place.

The extent of the seagrass at Cawsand (ha) was calculated as 28.67 ha. The previous extent of the seagrass bed at Cawsand was calculated as 11.97 ha (119,739 m^2) in 2012 (Curtis, 2012) and 18.62 ha (186,214 m^2) in 2018 (Bunker and Green, 2019). The extent of the seagrass has increased since the last survey in 2018, although the increase may be due to differing survey techniques.

9 Limitations

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

- The plant height (m) may not be the absolute plant height as some areas were surveyed over 2 hours either side of high or low water.
- 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 vessels pass by and cause a wake this causes ‘waves’ in the data which makes it hard to determine 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

Bunker, F. St. P. D. and Green, B. 2019. Seagrass condition monitoring in Plymouth Sound and Estuaries SAC. A report to Natural England from Menia Ltd.

Curtis, L.A. 2012. Plymouth Sound and Estuaries SAC Seagrass Condition Assessment 2012. Ecospan.

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

Visual Aquatic, 2021. Post-processing and data visualisation software for Biosonics echosounder systems.

Visual Acquisition MX, 2021. Real-time data acquisition and playback software for Biosonics MX Echsounder Systems.

12 Appendices

Appendix 1. **Vessel specification**

R/V Tiger Lily VI

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.

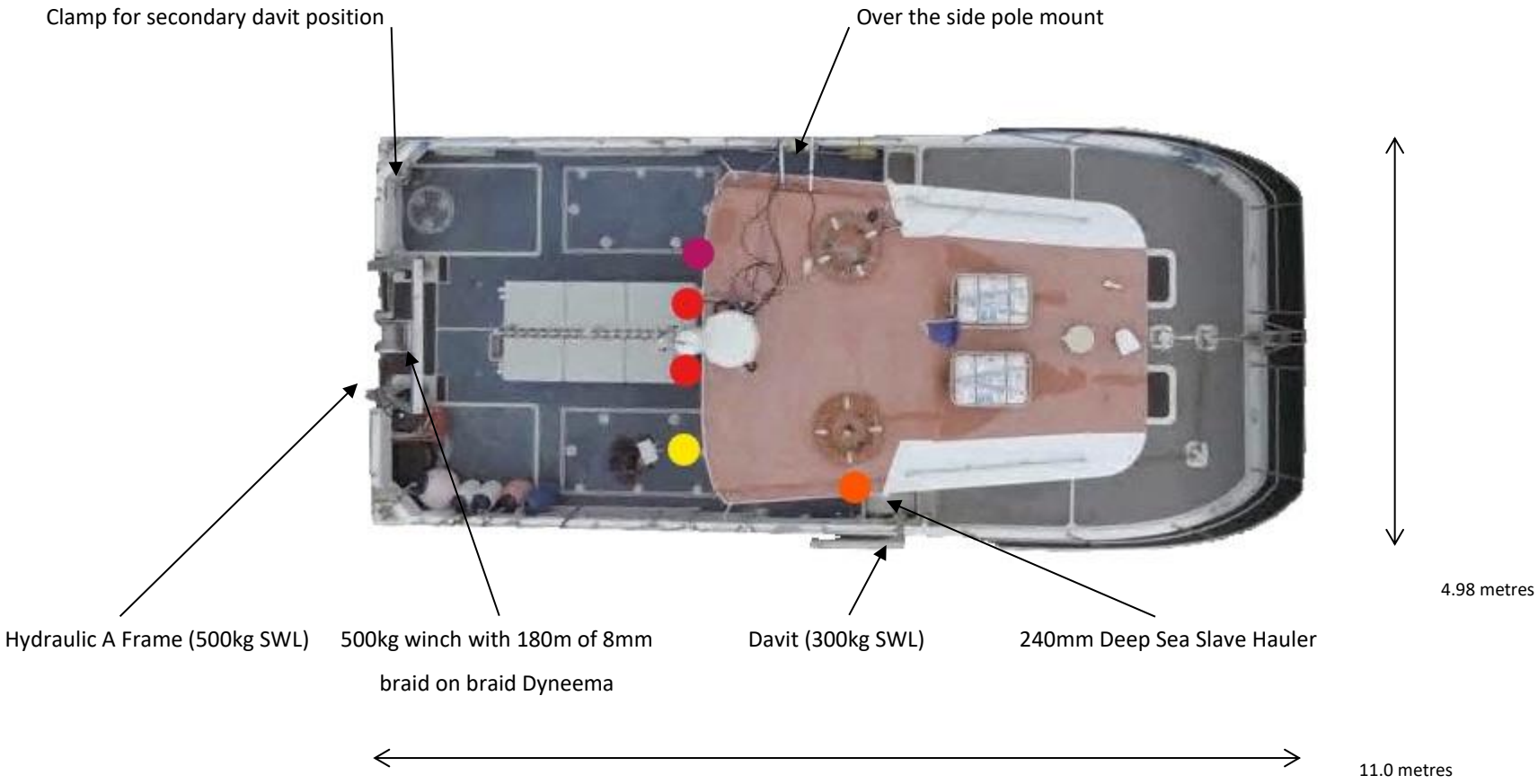
Annex Figure A: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

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

Appendix 2. Equipment specification

Positioning Software and Offsets



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

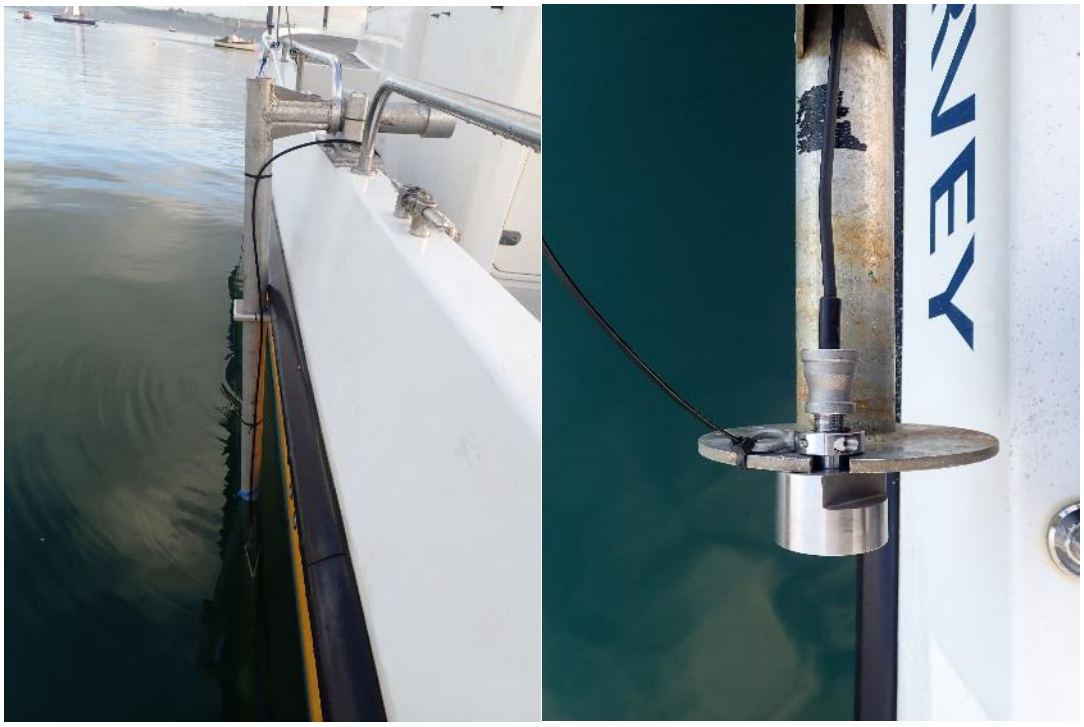
Details of the system are shown in Annex Table A and are available online:

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

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

Annex Table A: 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 B: 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 B and are available online:

https://www.valeport.co.uk/content/uploads/2021/05/Valeport-SWiFT-CTD-Datasheet.pdf

Annex Table B: 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 C: Valeport Swift Sound Velocity Profiler deployed from R/V Tiger Lily VI