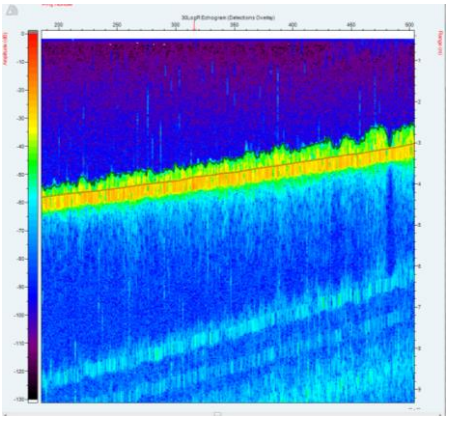
Acoustic Survey of the seagrass bed within Gerrans Bay 2022



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

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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.

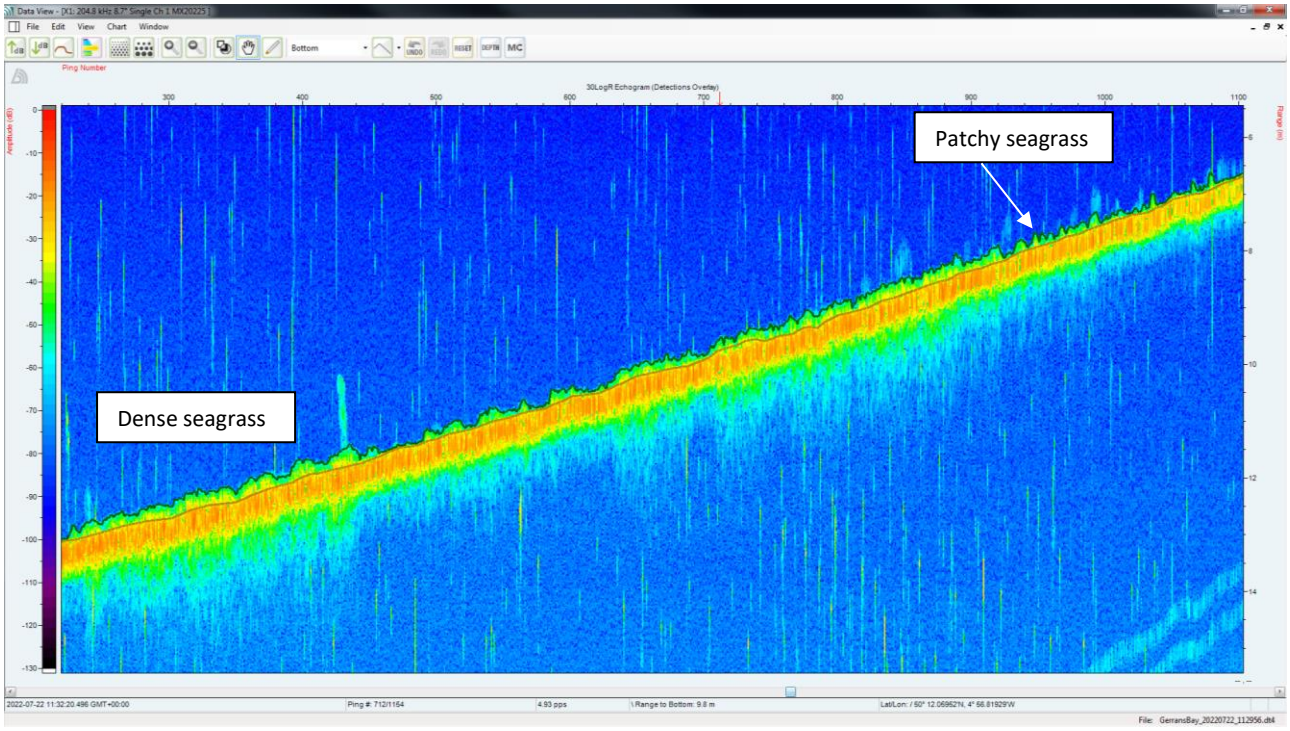

Figure 2: Bottom line (orange) and Plant line (green) in Visual Aquatic by Biosonics software in a dense seagrass bed and patchy seagrass within Gerrans Bay.

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

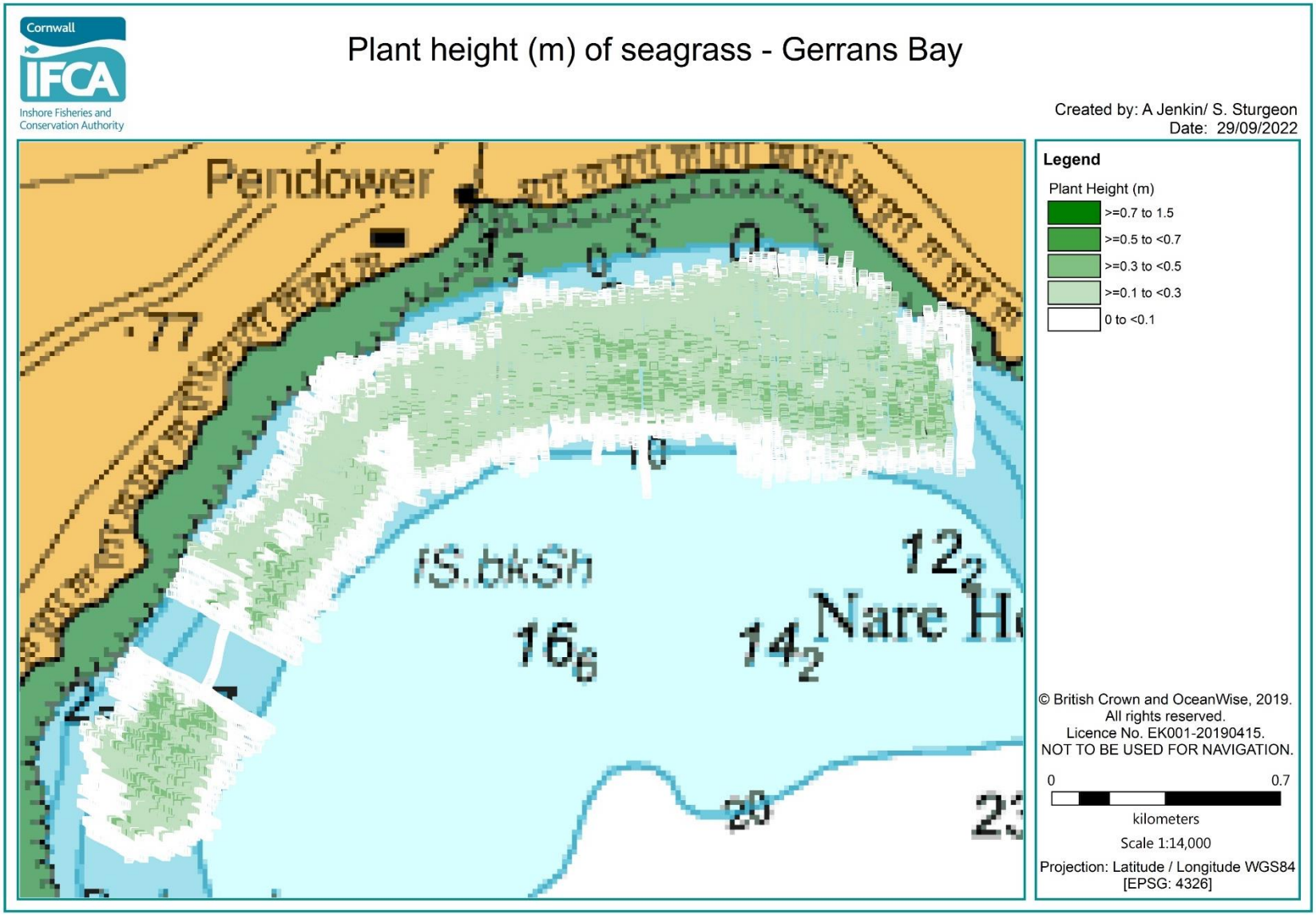

Figure 3: Plant height (m) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

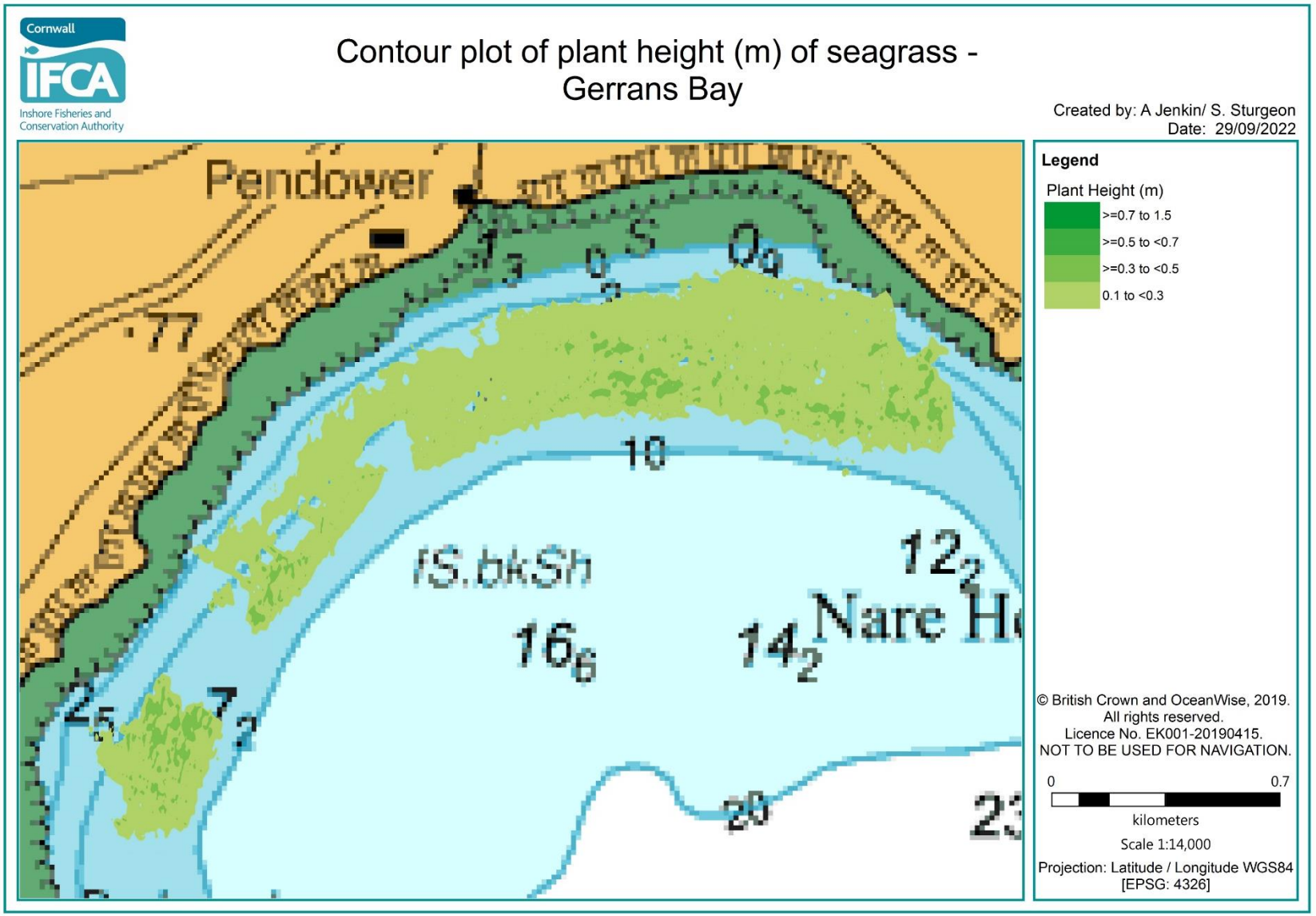

Figure 4: Contour plot displaying plant height (m) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

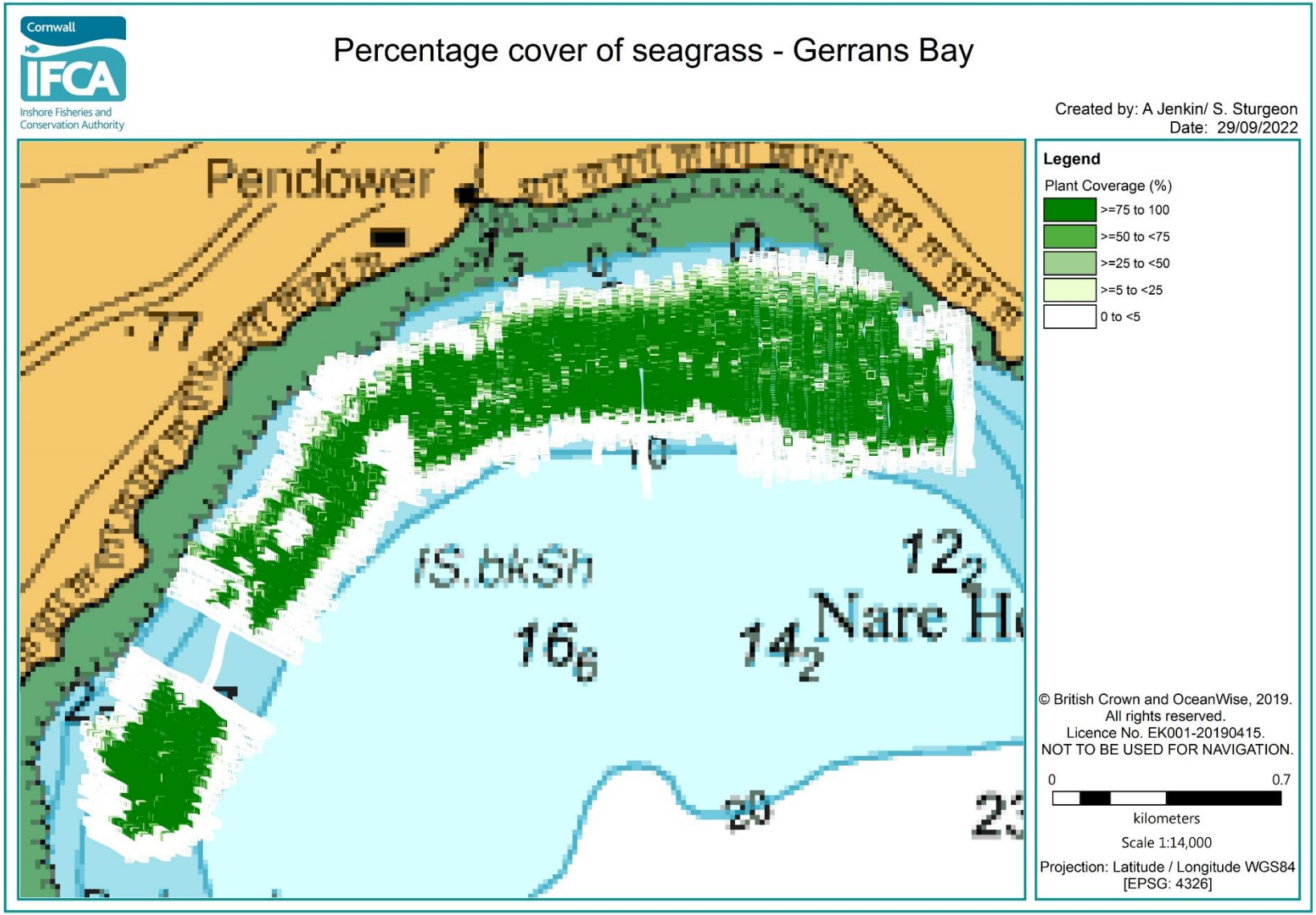

Figure 5: Plant coverage (%) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

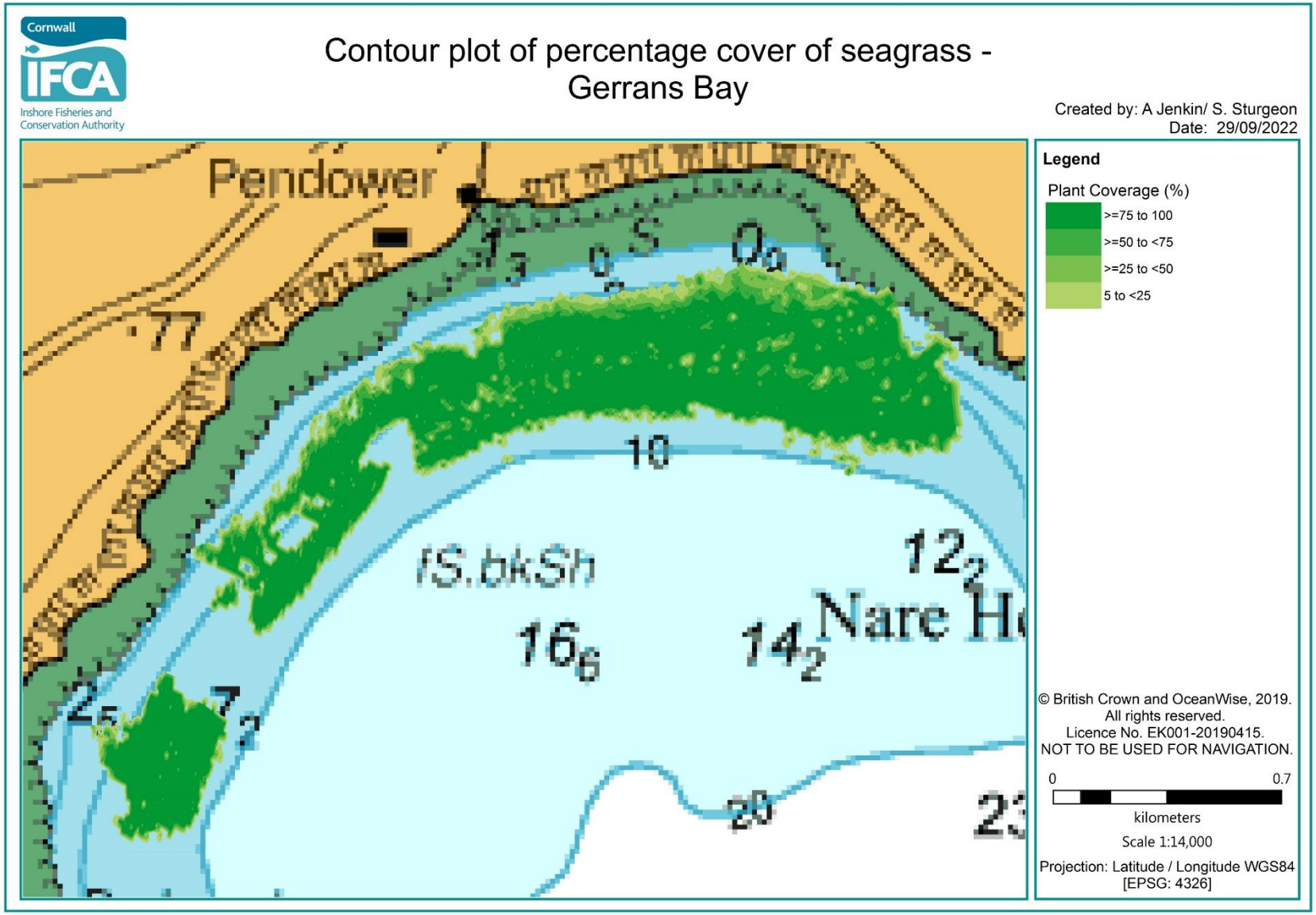

Figure 6: Contour plot displaying plant coverage (%) of seagrass (*Zostera marina*) completed within Gerrans Bay using an MX Echosounder by Cornwall IFCA 2022

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).

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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.

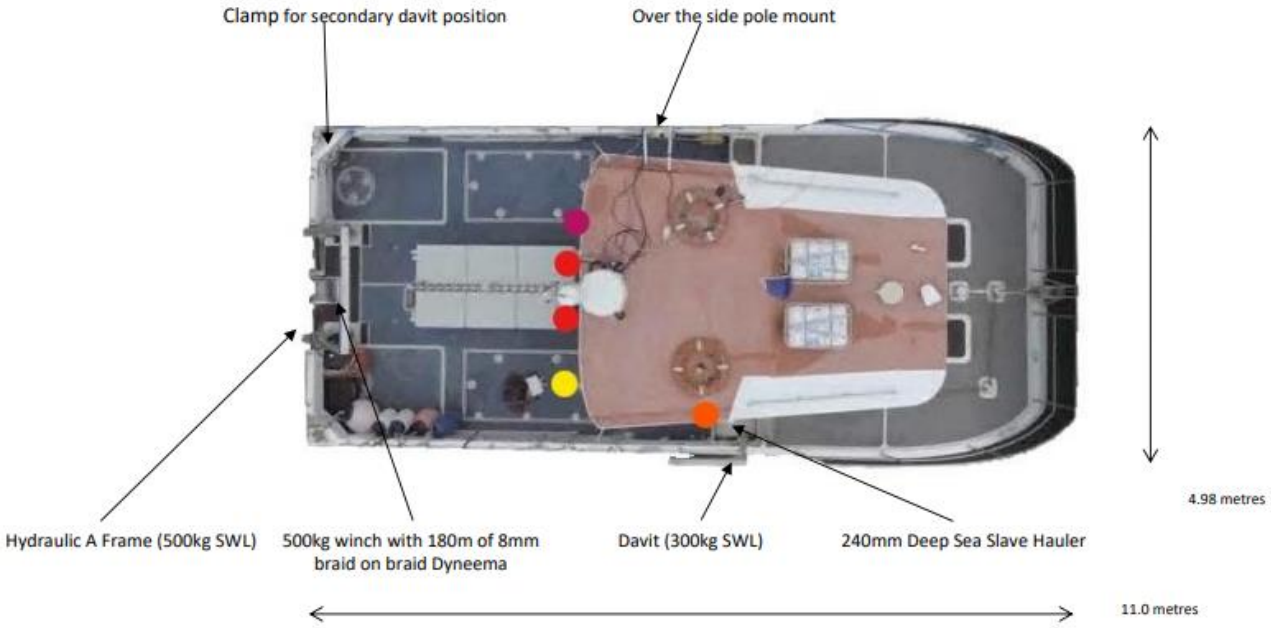
Annex Figure A: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

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

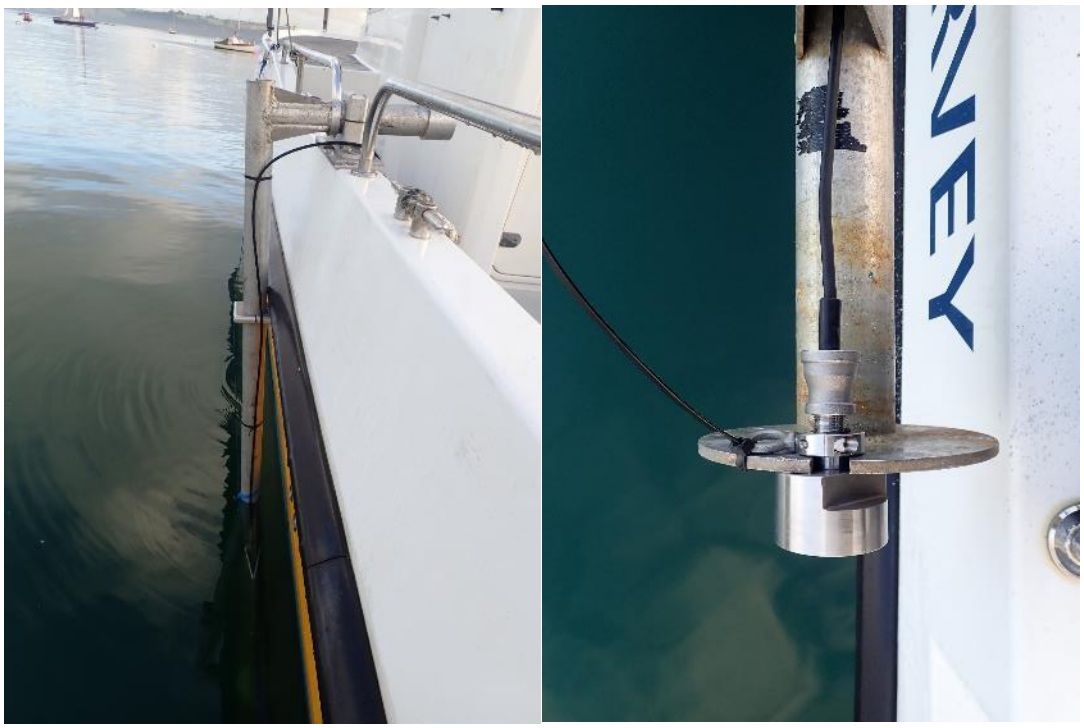
Details of the system are shown in Annex Table C and are available online:

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