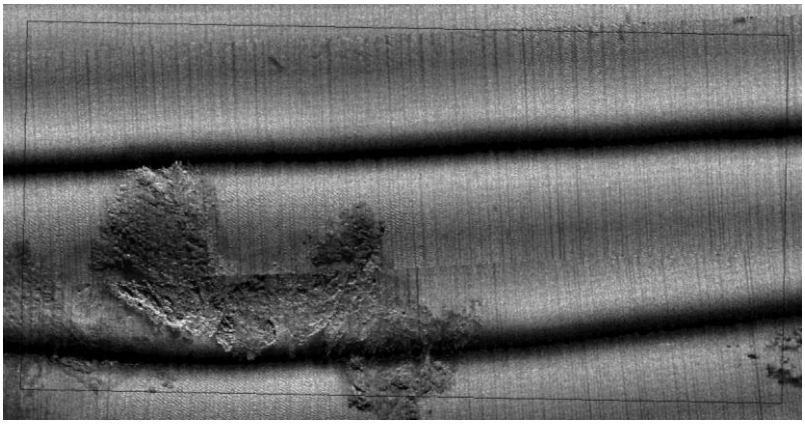
Eddystone Reefs Side-scan Sonar Survey 2017



Survey field report for the 2017 Eddystone Reefs Side-scan Sonar survey

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

Authors: Kimara Street, Annie Jenkin, Steph Sturgeon, Colin Trundle and Hilary Naylor.

Document History			
Version	Date	Author	Change
0.1	30/01/2018	K Street	Document creation
0.2	01/02/2018	C Trundle	Review and ammendments
0.3	01/10/2018	A Jenkin	QA
Final	05/10/2018	A Jenkin	Final amendments

Cornwall IFCA Eddystone Reefs Side-scan Survey Field Report 2017

This report may be cited as:

Street, K., Jenkin, A., Sturgeon, S., Trundle, C., and Naylor, H. 2017. Eddystone Reefs Side-scan Sonar Survey Field Report: 2017. Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA), Hayle.

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

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

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

Contents

List of Figures

List of Tables

Glossary of terms and abbreviations

DDV	Drop down video
ESI	University of Exeter Environment Sustainability Institute (ESI)
GIS	Global Information System
IFCA	Inshore Fisheries and Conservation Authority
SAC	Special Area of Conservation
SS	Side-scan
SSS	Side-scan sonar

1 Introduction

Cornwall Inshore Fisheries and Conservation Authority (IFCA), the Marine Conservation Society (MCS) and the University of Exeter Environment Sustainability Institute (ESI) are collaborating on a study in the Eddystone reefs, part of the Start Point to Plymouth Sound and Eddystone Special Area of Conservation (SAC). The project was funded by the Pigshed Trust between 2014 and 2016 and Princess Yachts International of Plymouth have committed to fund the project from 2017 to 2019.

The aim of this study is to collect data to enable a comparison of the epifaunal assemblages by statistical analysis within areas that are open and closed to bottom towed gear over time. The closure is a result of the European Marine Site management measures that were introduced in January 2014.

The data was from one treatment area that is within an area closed to bottom towed gears (Box 1) and two control areas where towed gears are allowed (Boxes 2 and 3) (Figure 1).

Annual drop down video surveys (DDV) have been conducted since 2014 by Cornwall IFCA, with analysis conducted by the ESI (Pikesley *et al.*, 2016).

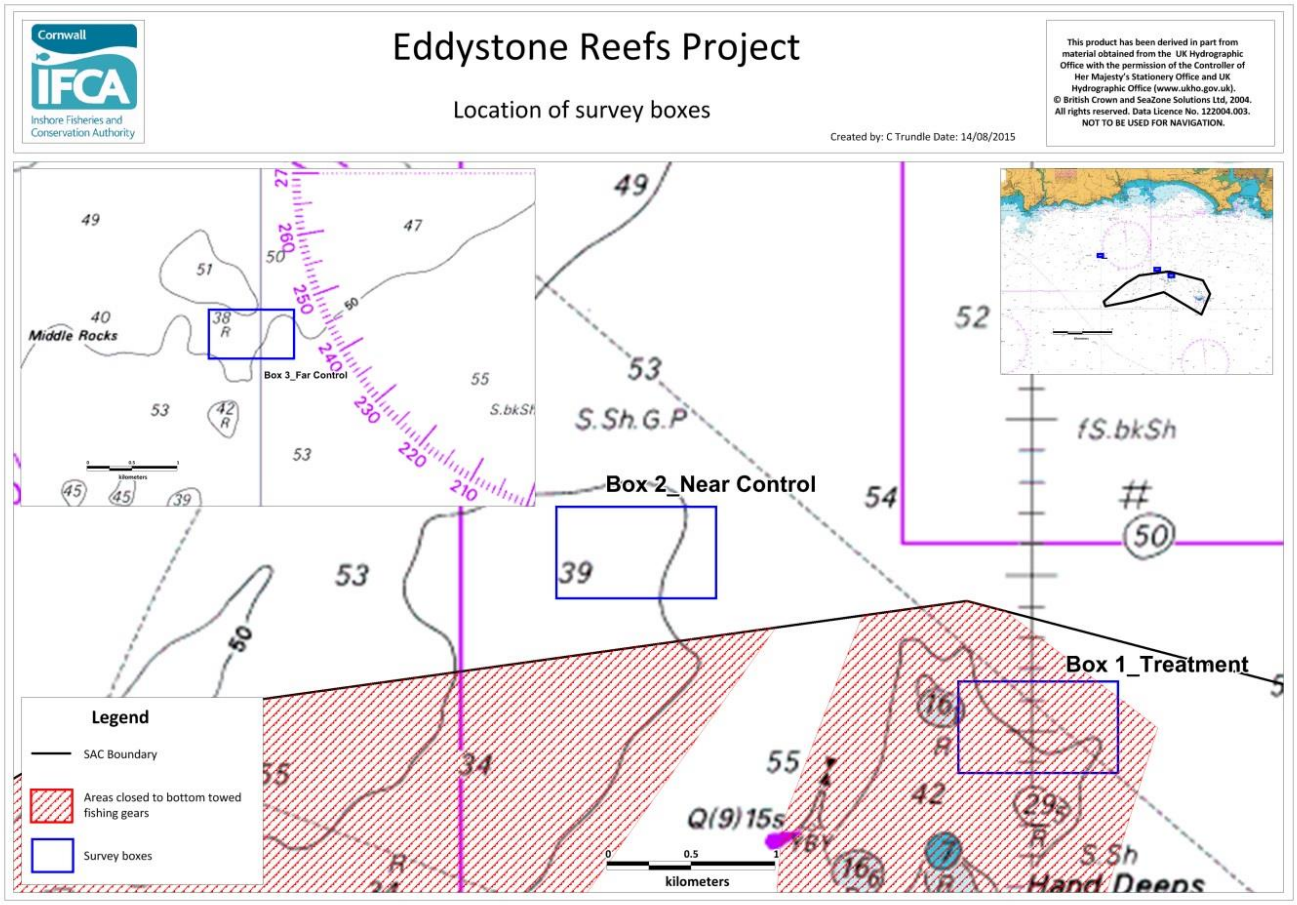


Figure 1: Location of the three survey boxes survey during the Eddystone Reefs project; Box 1 (closed to bottom towed gear), Boxes 2 and 3 (open to bottom towed gear).

The survey boxes were selected as areas with similar substrate and aspect; bedrock reef to the west with open sediment to the east. All three survey boxes had been subject historically to bottom towed gears. The selection

of sites was based on best available evidence at the time (Figure 2) from a range of sources including single beam bathymetry data collected from the Cornwall IFCA fisheries patrol vessel (FPV) Saint Piran, and side-scan sonar (SSS) data which was collected as part of the SAC site selection process.

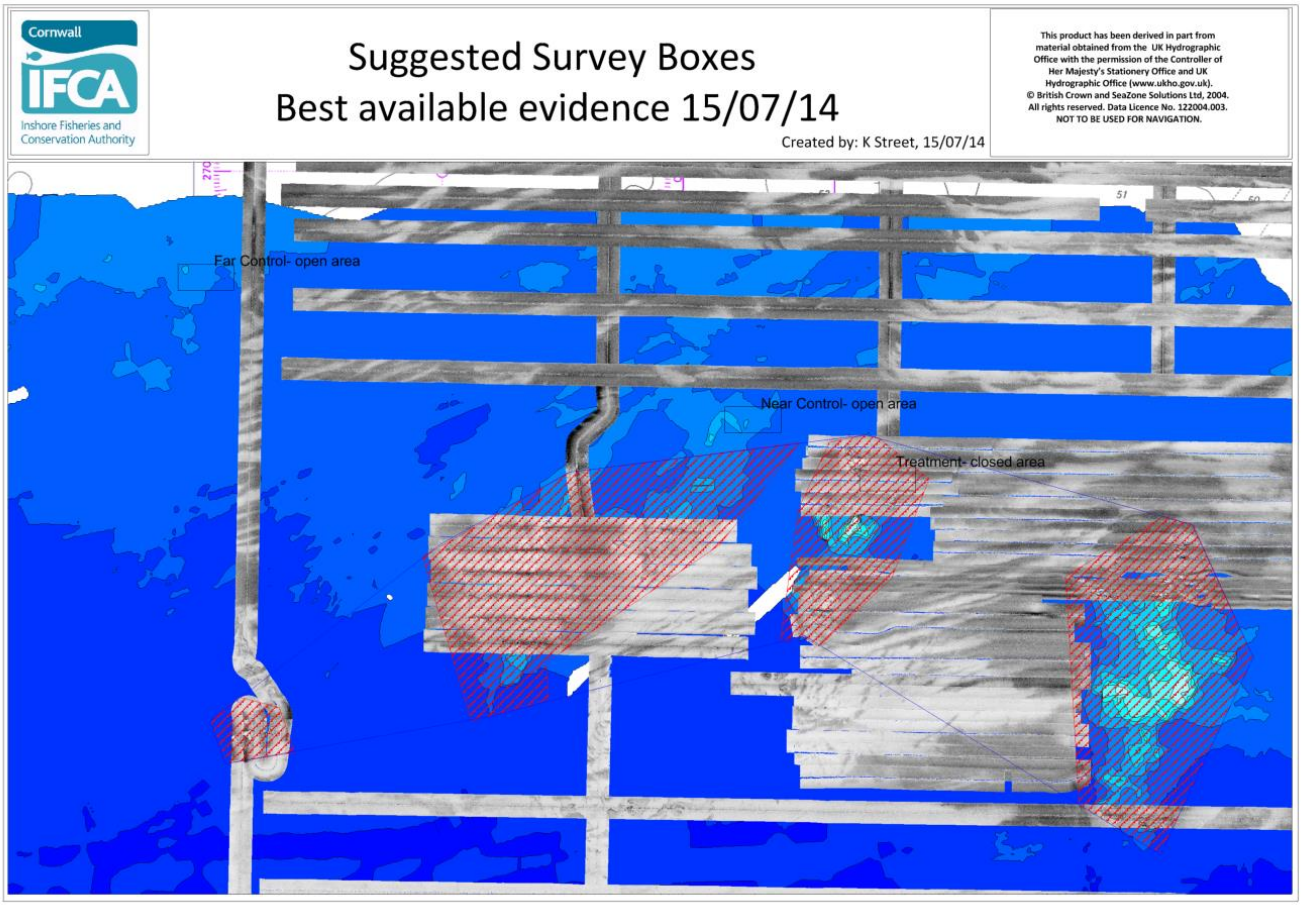


Figure 2: Best available evidence used for survey box selection; 100 kHz side-scan collected as part of SAC selection process, and modelled bathymetry data from single beam acoustic data collected by FPV Saint Piran. Red stripped polygons denote areas closed to bottom towed fishing gears.

It was identified that low frequency SSS data for all of the survey boxes would be desirable to aid during analysis and to quantify the area of reef and sediment in each of the survey boxes. Due to time, personnel, equipment and vessel constraints Cornwall IFCA had not been able to conduct a SSS survey of the project sites until 2017.

2 Aims and Objectives

2.1 Aims

- To achieve 100% low frequency side-scan sonar coverage (300kHz) for each of the survey boxes.

2.2 Objectives

- Collect 100% low frequency (300kHz) side-scan sonar data in each of the survey boxes
- Process the data and produce a mosaic output to be viewed in GIS software.

3 Methodology

3.1 Data Collection

Data collection took place on the 25th of July 2017 onboard research vessel R/V Tiger Lily VI which departed and returned to Mylor. The survey was undertaken from Cornwall IFCA's Research Vessel (R/V) Tiger Lily VI (Figure 3). This vessel has been refitted for survey work and includes a purpose built survey station within the wheelhouse (See Annex 1). R/V Tiger Lily VI has been fitted with an inverter and uninterruptable power supply (UPS) to provide stable 240 v power, NMEA outputs and a dedicated GPS with WAAS enabled. All position information was recorded in the Long/Lat WGS84 projection and taken from a single GPS (Furuno GP-32). 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.

Tiger Lily VI is an MCA coded Cat 2 vessel and is fitted with all necessary safety equipment including life rafts, first aid kits and fire suppression systems.

For the duration of the survey light southerly winds, <10knots, prevailed. High water Whitsand Bay was predicted as 5.46m at 08:04 BST and the survey was carried out on a dropping spring tide.

Figure 3: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

3.2 Personnel

The crew during the surveys consisted of the skipper and up to three scientific officers. The crew roles rotated during the surveys and roles included deploying and recovering the SSS, maintaining observation of the topside SS waterfall display and keeping a log.

3.3 Personal Protective Equipment (PPE)

Appropriate safety footwear and lifejackets with personal location beacons (PLBs) were worn at all times by members of the survey team whilst working on deck. Hard hats were worn during deployment and recovery of the SSS. No accidents or near misses were reported.

3.4 Acoustic survey

3.4.1 Equipment Specifications

The acoustic survey was carried out using a SSS. The SSS system works by emitting an acoustic signal that interacts with the seafloor and returns a signal which is interpreted based on its strength. Based on the reflectivity, different sediment types can be seen.

An EdgeTech 4200 dual Frequency SSS system, with 300/600 kHz operating frequencies was used for data collection. EdgeTech 'Discover 4200-MP' (Version 33.0.1.112) software was used for data capture, and EdgeTech 'Discover Coverage Mapper' (Version 1.02) used to display swath coverage to ensure 100% coverage of the low frequency data (300 kHz) was achieved in each of the survey boxes. A Furuno GP-32 GPS was used for all positional data, the GPS attenna is mounted on the starboard side of the wheel house roof (See Annex 1).

The equipment specifications of the side-scan sonar system are shown in Table 1. Details of the system are available online: http://www.edgetech.com/pdfs/ut/4200-Brochure-122012.pdf

Table 1: Details of the side-scan sonar system used for the side-scan survey carried out by Cornwall IFCA

Equipment	Camera System
Manufacturer	Edgetech
Model	Edgetech 4200 side-scan sonar
Frequency	Dual frequency (300/ 600 kHz)

3.4.2 Side-scan sonar Methodology

The SSS was connected to the tow line and data cables on the stern deck of the vessel. The computer was set up on the workbench inside the wheel house. The system was tested prior to deployment on the journey from Mylor Harbour, Falmouth to the survey site. Once on site the SSS was deployed from the A frame on the stern of the vessel. The SSS was then towed on a trial run to determine the correct gain and time viable gain (TVG) levels, after the trial run the settings were kept constant. To achieve a 300m swathe at 300kHz an altitude of 30m from the seabed was required (10% of range). The depth of the SSS was changed by altering the amount of tow line fed away via a hydraulic winch, the altitude (height above the seabed) of the tow fish was determined

by the depth of the seabed from the sounder. A best suited altitude (10% of the desired range) was applied where possible. During deployment the survey vessel maintained a speed over the ground (SOG) of 4-4.5 knots whilst survey crew increased the length of tow cable deployed until the topside recording equipment read ~30m altitude. The layback of the SS from the survey GPS antenna was calculated to be 90m and maintained for the duration of the survey. The offset of the antenna was combined with the length of deployed warp to estimate the layback of the sonar fish.

Once the crew were happy and all checks and set up procedures were complete the survey skipper positioned the vessel at the start of the first tow line with a steady course and constant speed and the start of line (SOL) was recorded. Recording of data was started when the towing speed was between 4-4.5 knots and a consistent heading was maintained. The SOG of 4 – 4.5 knots was kept consistent for lines going both into and with the tide to maintain the number of acoustic 'pings'/meter of seabed. Recording was stopped at the end of each tow and re-started at the start of the next tow when the vessel was maintaining a constant heading and speed.

Due to the orientation of the survey boxes, east/west tows were planned to achieve maximum coverage with the minimum number of tows. In Box 1 however, this methodology had to be altered because of the steep reef pinnacles to the west of the survey box which did not allow for the survey vessel to turn safely whilst towing the SS. In Box 1 therefore tows were conducted north/south.

Data were recorded in .jsf and .xtf formats. No lay back was applied to the .xtf files, nor were any display gains recorded. At the end of the survey all data were transferred to an external hard drive.

3.4.3 Analysis Methodology

The .xtf files were loaded into Coda Octopus 'GeoSurvey' (Version 6.1.0). The first tow was played back in the waterfall display then an area of homogenous sediment across the whole scan was selected as a trial area to optimise the display preferences. Image enhancement was applied, inverting the grey scale to give white as high and black as low backscatter, and gamma value increased to 1.2. The data was scaled using auto scale in the 'Scale Display Data' setting to achieve optimum display scale and gains. 'Time-Varying Gain' (TVG) was applied to increase the gain at the outer edges of the swathe and lower the gain in the lower end of the range. These settings were saved and 'locked' to be applied to all tows.

'Auto tracking: Sidescan edge detection' was used to calculate the seabed position, set at 30% sensitivity. This was then played back to manually check for, and correct, any errors. 'Slant Range Correction' was then applied before loading the file into Coda Octopus, GeoSurvey Mosaic (Version 5.16). This process was repeated for each tow.

Once all tows were loaded into Mosaic the 90m layback was applied to all data. All adjacent and overlapping tows were checked for positional errors, where seabed features did not match up, which may have been a result of an incorrect layback being applied. For all tows in Box 1 and Box 2 no errors were observed. In Box 3, two

survey lines did not appear to match the remaining three. These two tows were collected running in the opposite direction to the remaining three, and it is likely that the effect of tide on the SS may have altered the layback distance differently depending on if the tow was with or against the tide. It was decided that the calculated layback of 90m be applied to the three tows where the features appear to match and a smaller layback applied (80m and 60m) to the other two tows to bring them in line with the other data.

'Navigation Smoothing' was applied to all data removing outliers. The tows were layered to ensure the clearest data was displayed on top. The images for each survey Box were exported as a 'North Up GeoTiff', at a resolution of 2 pixels per geographical metre. A geotiff is an image file that has an additional data file that provides geographic positioning enabling the image to be used in a GIS.

To test the accuracy of the calculated lay back and positioning the mosaic was loaded into MapInfo Pro (Version 15.2.0) and overlaid on the modelled single beam bathymetry data, from 2014. Obvious seabed features, such as bedrock outcrops, were used to see how well the selected features aligned in both data sets.

4 Results

100% coverage was achived in survey Boxes 1 and 2 (Figure 4 and Figure 5 respectively), however in Box 3 a small area, 0.01 km^2, appears to have been missed (Figure 6).

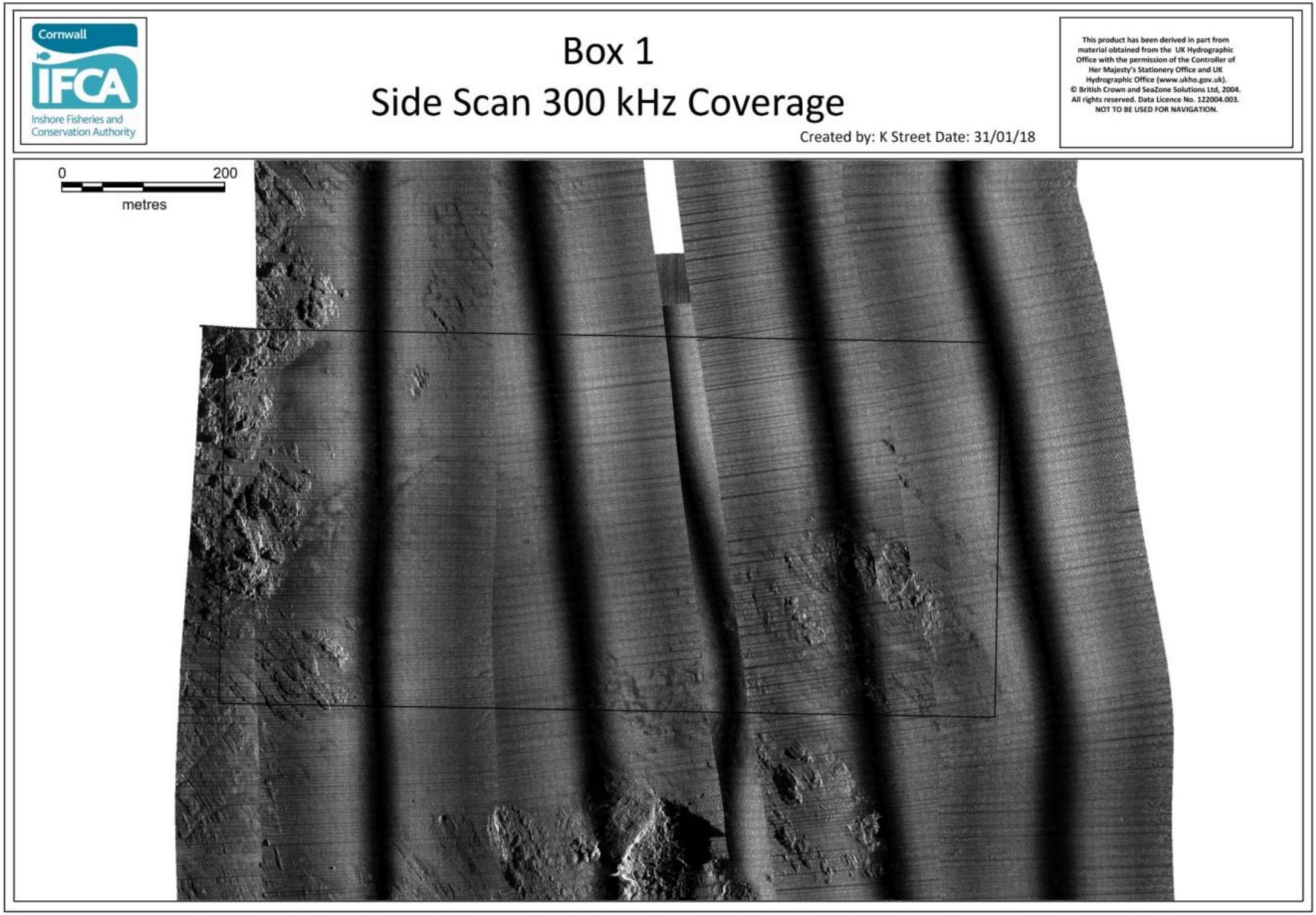


Figure 4: 300 kHz side-scan coverage achieved in Box 1 (black line) by Cornwall IFCA during the 20170725 survey.

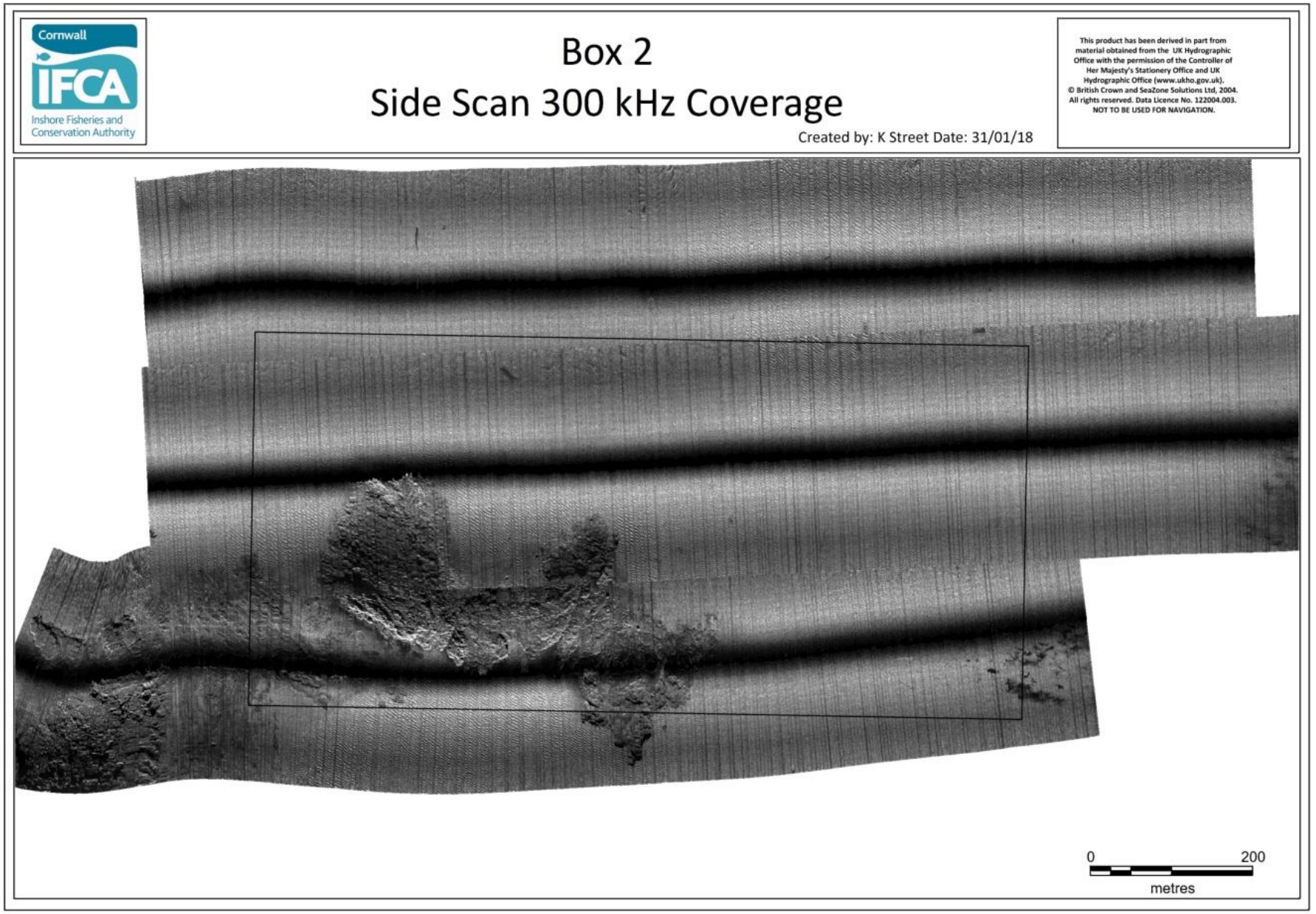


Figure 5: 300 kHz side-scan coverage achieved in Box 2 (black line) by Cornwall IFCA during the 20170725 survey.

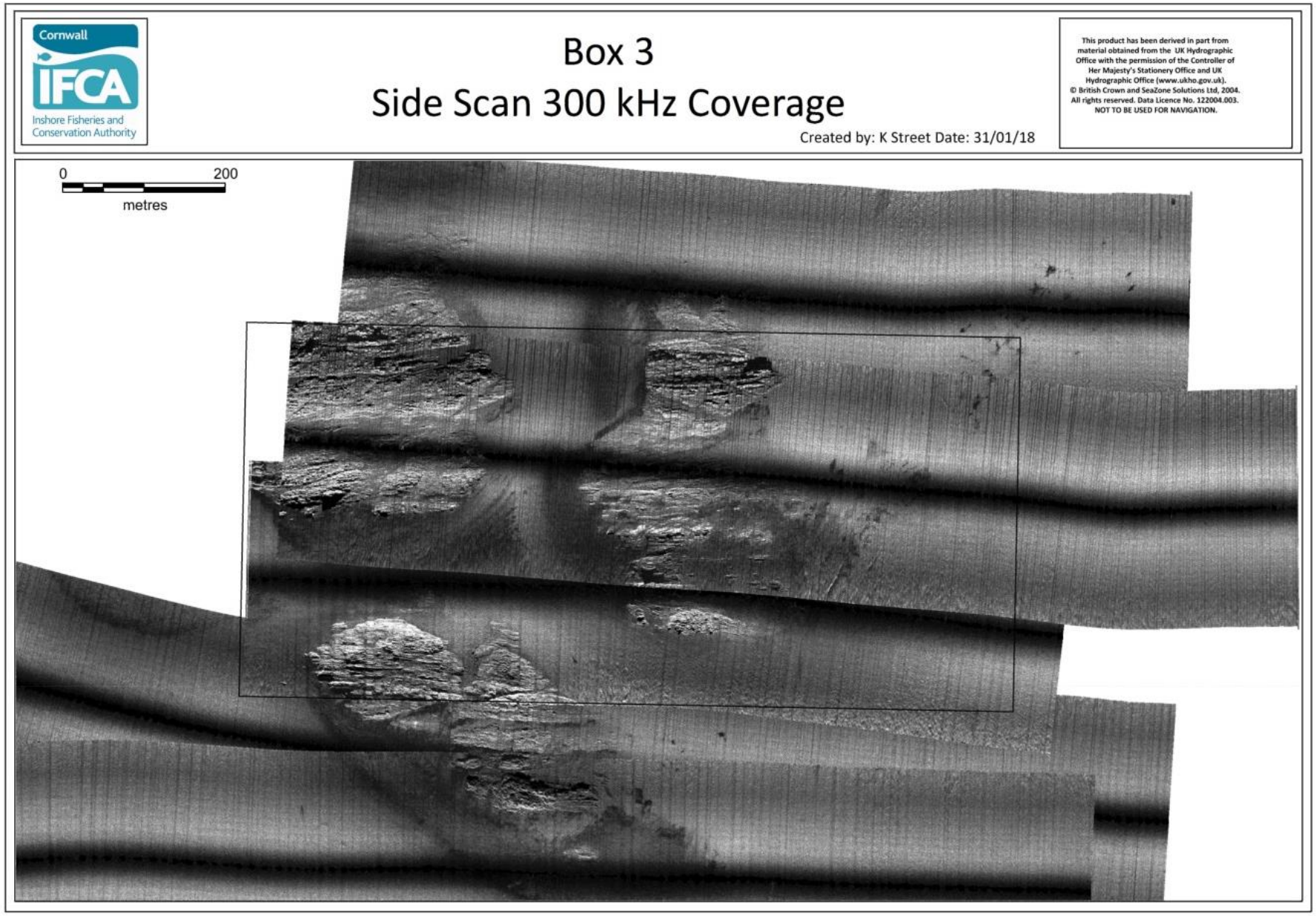


Figure 6: 300 kHz side-scan coverage achieved in Box 3 (black line) by Cornwall IFCA during the 20170725 survey.

5 Discussion

Cornwall IFCA were largely successful in achieving 100% coverage of low frequency 300kHz SSS data in the survey boxes. A small area in Box 3 was missed, it is unclear how this happened but it may be due to an incorrect layback being applied to the data during processing, or an error in data collection.

The data collected will provide useful information during analysis of the data collected from the DDV survey.

6 Recommendations

- In light of the difficulties in matching tows in Box 3, future improvements to data collection methodology may include some perpendicular tracks to the survey lines to allow for corrections in fish positioning with more confidence.
- Cornwall IFCA has recently purchased a USBL which can be attached to the SSS which would allow for exact positioning of the SSS, removing the need for estimating a layback from the survey vessel manually. This should eliminate any positional errors in the future.

7 References

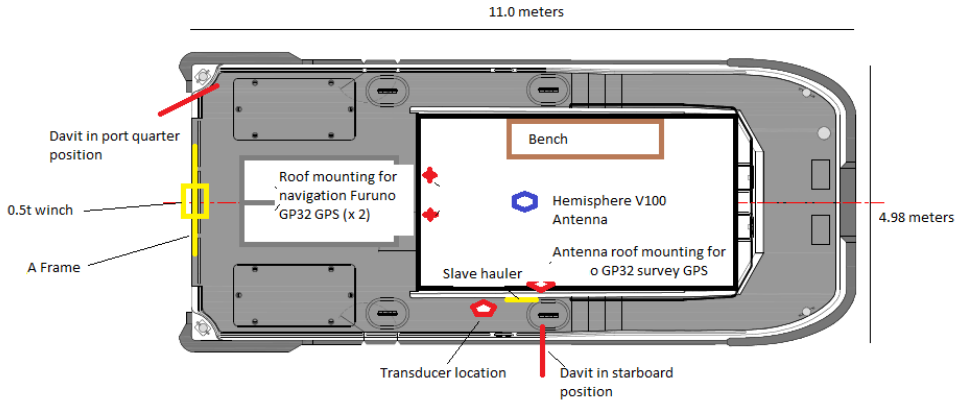
Piksely, S.K., Soland, J.L., Trundle, C., and Witt, M.J., 2016. Eddystone Reef Camera Survey Summary Report 2014-2016.

8 Appendix

Annex 1 - Tiger Lily VI Deck Plan and Offsets

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 V100 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

Tiger Lily VI General Layout - Plan view



			Offset (m)		
NMEA Device	**Make/Model**	**Offset Name**	**X (f'wd)**	**Y (port)**	**Z (+/-)**
Sounder	Furuno Navnet	Transducer	7.0	4.2	-0.5
GPS	Furuno GP32	GPS 1	4.8	3.48	+2.2
GNSS	Hemisphere V100	GNSS 1	5.0	2.5	+2.35