



Scallop Dredging Trial off Portloe 2019



Portloe Scallop Dredging Trial Field Report

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

Authors: Kate Owen, Colin Trundle, Annie Jenkin, Steph Sturgeon, Hilary Stidwell and Kimara Street

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

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

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1 Project Background

The 2017 Centre for Environment, Fisheries and Aquaculture Science (Cefas) Initial Assessment of Scallop stocks identified the 'Inshore Cornwall' king scallop (*Pecten maximus*) stock area as one of five areas of importance in the English Channel to UK fisheries. Within this area two commercially exploited scallop beds are identified, both within the 6 nautical mile boundary. In 2016 approximately 2,938 tonnes of king scallops were landed from these beds, by both UK and international vessels (Bell, E; 2018).

Cornwall Inshore Fisheries and Conservation Authority (CIFCA) is the authority responsible for the sustainable management of sea fisheries in the Cornwall IFCA district, which extends to 6 nautical miles from coastal baselines. Dredging for king scallops in the Cornwall IFCA district is currently subject to a number of byelaws, including; Shellfish Boats Byelaw, Scallop Dredge (Limited Fishing Time) byelaw and Methods of Fishing (Dredges) byelaw. These byelaws limit boat size to 16.46m in the district, prohibit scallop dredging between 7pm and 7am and stipulate gear requirements, including a limit of 12 dredges per vessel at any one time (Cornwall IFCA, Accessed at: www.cornwall-ifca.gov.uk/scalloping).

Cornwall IFCA's research team are preparing to start annual dredge tow surveys for scallops within the district. Currently the proposal is to conduct annual survey tows at a number of inshore sites within the district which were previously regularly surveyed by CEFAS along with some new sites. Data from these surveys, in conjunction with the larger current Cefas Stock Assessment program, would help to guide management of this fishery in inshore waters.

In addition Cornwall IFCA will be using their research vessel (R/V) Tiger Lily as a platform for Cefas to conduct scallop tagging trials in the future.

1.1 Aims and objectives

1.1.1 Aims

To develop a suitable method for repeat surveying for scallops from R/V Tiger Lily, to be used in multiple locations.

1.1.2 Objectives

- To trial the effectiveness of the N-Virodredge and tow bar for dredging for scallops from R/V Tiger Lily
- To obtain measurement of all scallops (*P. maximus*) collected
- To trial identifying and measuring the growth rings on individual scallop shells for ageing purposes

2 Methodology

2.1 Survey Area

The dredge survey was conducted off Portloe, in Veryan Bay, off the south coast of Cornwall (Figure 1). This area was chosen for the trial as it was a previous Cefas survey location and during previous survey work by Cornwall IFCA a significant number of small scallops were observed on wrasse fishing gear. In addition, Cornwall IFCA has side scan sonar data for this area, which allowed the substrate and any possible dredge hitches to be identified.

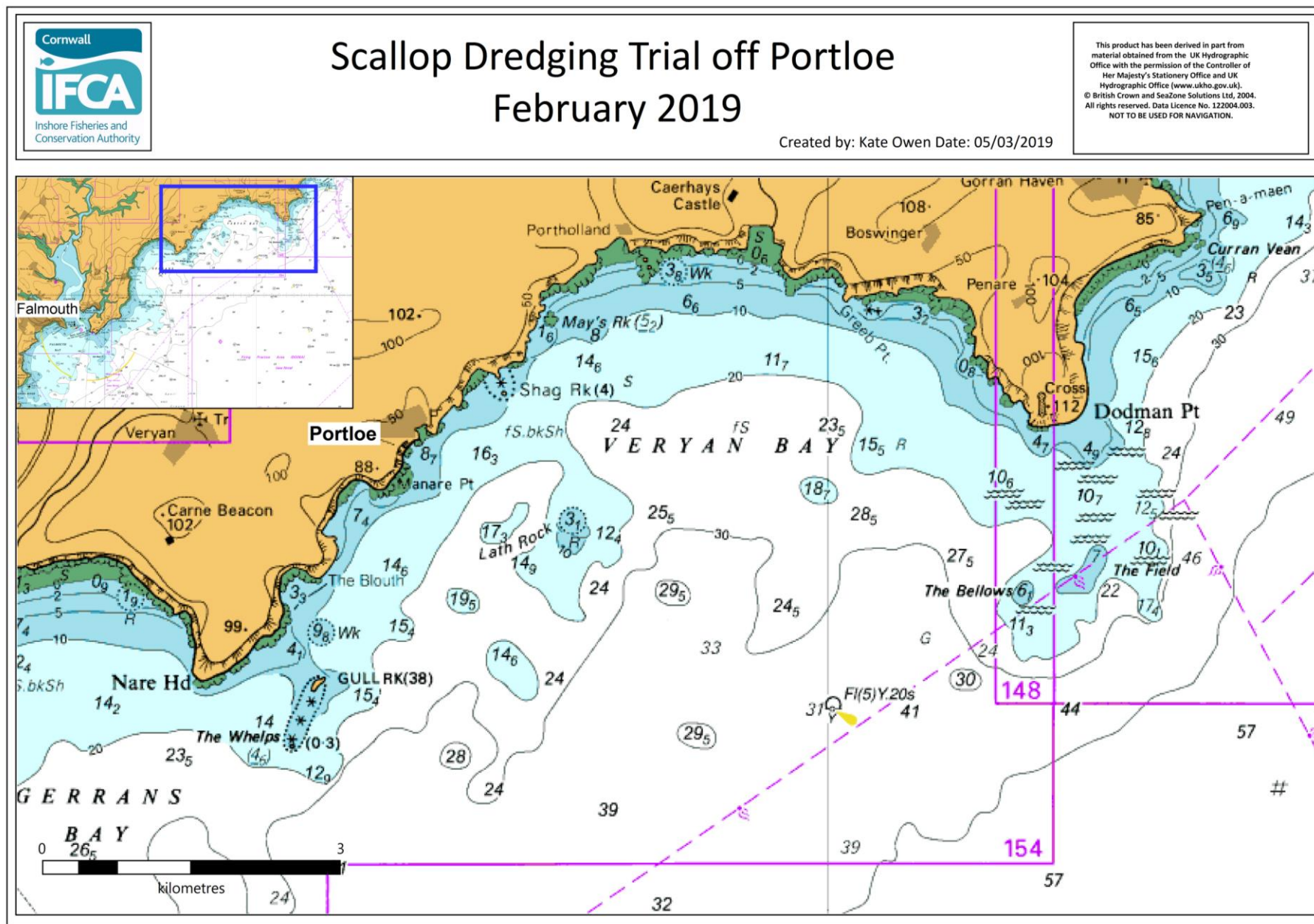


Figure 1: Survey area in Verran Bay, off the south coast of Cornwall, used for the scallop dredging trials.

2.2 Vessel Specification

R/V Tiger Lily has been refitted for survey work and includes a purpose built survey station within the wheelhouse, fitted with an inverter and uninterruptable power supply (UPS) for stable 240v power, NMEA outputs and dedicated GPS with WAAS enabled (Figure 2). All position information was recorded using the Lat/ Long WGS84 projection taken from the dedicated survey GPS receiver. All times recorded are in UTC from a single source, a Furuno GP32 GPS. R/V Tiger Lily VI is MCA coded to Cat 2 and is fitted with all necessary safety equipment, including life rafts, lifejackets, first aid kits and fire suppression systems.



Figure 2: Cornwall IFCA's dedicated survey vessel, R/V Tiger Lily VI.

2.3 Personnel

The crew on the 28th February 2019 consisted of four Cornwall IFCA scientific officers (CT, AJ, SS and KO) and an independent skipper.

2.4 Personal Protective Equipment (PPE)

While working on deck all crew and were required to wear lifejackets, personal location beacons (PLBs), hard hats and steel toe cap boots. A Toolbox safety talk was carried out at Mylor before R/V Tiger Lily departed for the survey. All personnel were made aware before the dredge was deployed or hauled. During deployment or hauling good communication was maintained between the winch operator and Scientific Officers on deck to deploy/recover the dredge. Only necessary personnel were working around the A-Frame during deployment or recovery, with other crew standing clear. No accidents or near misses were reported.

2.5 Equipment Specification

A single N-Virodredge™ mounted on a custom designed tow bar was used during the survey. The N-Virodredge has the same width as a traditional scallop dredge (76cm), but uses individually mounted spring loaded tines, as opposed to a steel tooth bar to penetrate the sea bed. A shackle was used to connect the N-Virodredge to a central towing point on the custom made 1.8m tow bar (Figure 3).

The winch on Tiger Lily's A-Frame (Spencer Carter 0.5t) was used to deploy and recover the dredge. Dyneema cable from the winch was used for towing. The slave hauler on the starboard side of Tiger Lily was rigged around the front of the vessel to the davit in the port quarter position. This hauler was used to raise and lower the end of the dredge bag for emptying the contents on to the deck.

GPS track data was recorded in Hypack®MAX for the duration of the survey and all targets / waypoints created in Hypack. All positions in Hypack are sourced from the dedicated survey GPS (Furuno GP-32) on board and times in Coordinated Universal Time (UTC) are taken from the same source.

Vernier stainless steel callipers were used for all shellfish measuring on board.



Figure 3: N-Virodredge (left) (Image from N-Virodredge.com) and the N-virodredge mounted on R/V Tiger Lily's A-Frame (right)

2.6 Methodology

The N-Virodredge was deployed through the A-Frame at the stern of Tiger Lily, using the onboard winch, whilst the vessel motored slowly forwards. Once the dredge was clear of the deck and at the surface of the water winching was halted. A lowered towing point was then created by attaching a chain with a connected towing block across the bottom of the A-Frame. The Dyneema cable was then run through this lowered towing point (Figure 4).



Figure 4: Lowered towing point on the A-Frame of R/V Tiger Lily with Dyneema towing cable running out to the N-Virodredge.

The winch was then used to lower the dredge onto the seabed. The length of Dyneema cable out varied slightly (70-95m) with each tow, but was approximately three times the water depth. Once the dredge was on the seabed a start-of-line (SOL) position was created in Hypack.

R/V Tiger Lily motored forward at a speed of 2-3 knots for the duration of the tows. The first two tows were considered trial tows and not of a set length. The remaining three tows were a nautical mile in length and considered three replicates, with tows 3 and 5 running in the same direction and tow 4 running in the opposite direction.

Once tows were completed an end-of-line (EOL) mark was created in Hypack. The winch was then used to recover the dredge to the stern of the vessel. The lowered towing point was removed, before the winch was used to recover the dredge and tow bar onto the deck (Figure 5 and Figure 6).



Figure 5: Scientific Officer directing the winch operator to recover the dredge to the deck of R/V Tiger Lily



Figure 6: Dredge recovered to the deck at the stern of R/V Tiger Lily

The tow bar wheels were chocked with wood to secure the equipment. A line from the slave hauler, run through the port quarter davit was then connected to the rear of the dredge bag. The hauler was used to raise the end of the dredge bag and empty the contents on to deck (Figure 7).



Figure 7: Slave hauler being used to raise the end of the dredge bag and empty the contents onto the deck of Tiger Lily

Before any catch sorting the slave hauler was used to lower the dredge bag back onto deck and the winch then used to move the dredge and tow bar into the water at the stern of the vessel.

The catch from each tow was photographed, before the scallops were sorted into a fish box. The height of all scallops was measured from the umbo to the mantle and a width measurement was taken across the widest point, all to the nearest mm (Figure 8). Scientific Officers then trialled recording the length of each growth ring from the umbo of the scallop (Figure 9 and Figure 10). These rings each represent a year's growth and can be used to age the scallops. The flat valve was used to determine growth rings, with lines on the curved valve used to confirm any uncertainties. Where rings were difficult to distinguish on the scallops a 'low confidence' mark was noted with the measurements.

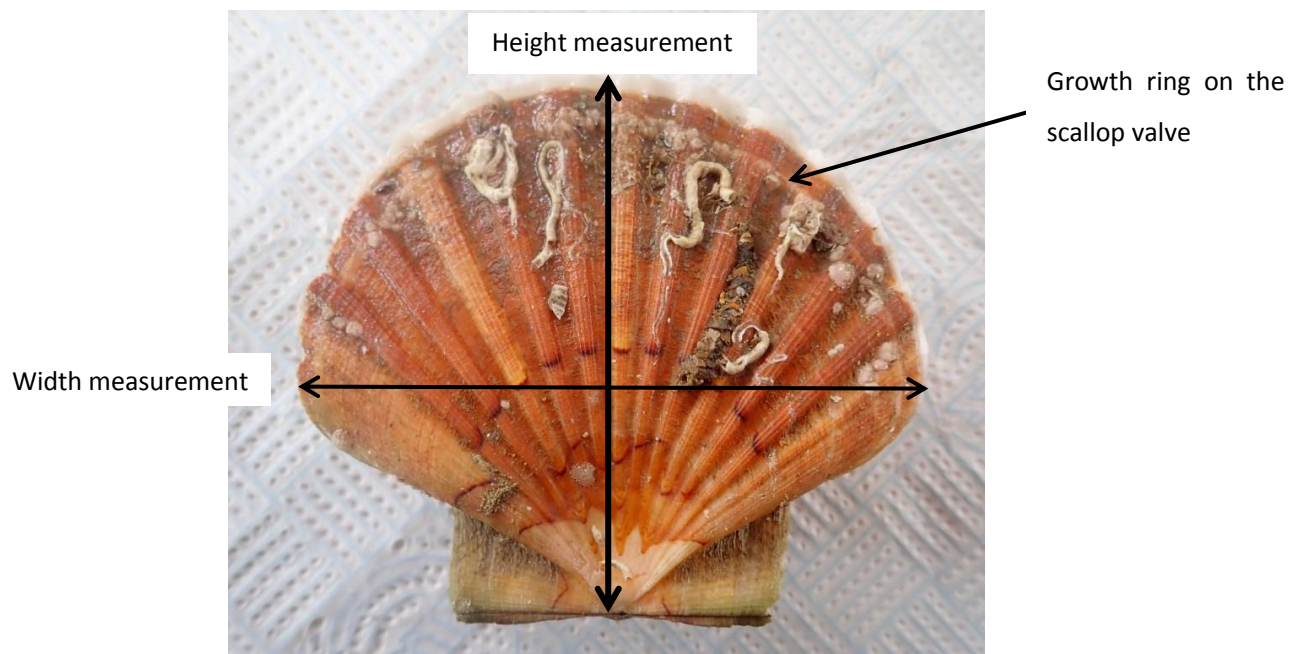


Figure 8: Scallop (*Pecten maximus*) shell showing the measurements taken by Scientific Officers and identifying one growth ring



Figure 9: Scallop (*Pecten maximus*) shell showing growth rings as estimated



Figure 10: Cornwall IFCA Scientific Officer measuring the growth rings on a scallop (*Pecten maximus*) shell

2.7 Data Handling

Scallop measurement data was entered *in situ* into a recording sheet which was set up in Microsoft Excel. At the end of the survey this spreadsheet was transported back to the office via a hard drive and stored on the Cornwall IFCA servers. All photographs taken as part of the survey were again transferred to Cornwall IFCA's servers and stored in the same folder as the data, labelled with the survey title and date. At the end of the survey all track and target data was exported from Hypack in a .txt file format and stored on the Cornwall IFCA servers.

2.8 Data analysis

The GPS tracks of all tows were plotted in MapInfo Pro v17.0 over hydrographic charts and side-scan sonar data of Veryan Bay. Microsoft Excel was used to plot charts of scallop height, width and age class.

3 Results

In total five scallop dredge tows were successfully completed. The location, time and depth of each tow are shown in Table 1. The first two tows were considered trial tows and were approximately 10 and 13 minutes in length. The 3rd, 4th and 5th tows were considered to be three replicates, covering the same ground, with each lasting over 20 minutes and covering approximately a nautical mile in length. Tows 3 and 5 ran in a south-westerly direction, whilst Tow 4 ran over the same ground in a north-easterly direction.

Table 1: Summary data from the five tows conducted in Veryan Bay by Cornwall IFCA on the 28/02/2019

Name	WGS84 Latitude	WGS84 Longitude	Depth (m)	Time	Date	Speed (knots)	Cable out (m)	No. of scallops
SOL Tow 1	50.20012 N	4.882863 W	33.3	09:34:31	28/02/2019	3	70	1
EOL Tow 1	50.206362 N	4.878413 W	29.6	09:44:35	28/02/2019			
SOL Tow 2	50.207432 N	4.877677 W	28.9	10:00:25	28/02/2019	3	90	15
EOL Tow 2	50.217068 N	4.870895 W	24.6	10:13:46	28/02/2019			
SOL Tow 3	50.217032 N	4.871013 W	24.6	10:27:42	28/02/2019	2	90	26
EOL Tow 3	50.200072 N	4.882712 W	33.8	10:56:56	28/02/2019			
SOL Tow 4	50.20036 N	4.882913 W	33.5	11:20:52	28/02/2019	3	95	23
EOL Tow 4	50.217197 N	4.870335 W	25.8	11:43:49	28/02/2019			
SOL Tow 5	50.21671 N	4.87042 W	24.8	12:04:08	28/02/2019	3	95	9
EOL Tow 5	50.199037 N	4.883992 W	34.2	12:31:16	28/02/2019			

The location of each scallop tow in Veryan Bay is shown in Figure 11 below. Figure 12 shows the tows overlaid onto side-scan sonar data for Veryan Bay.

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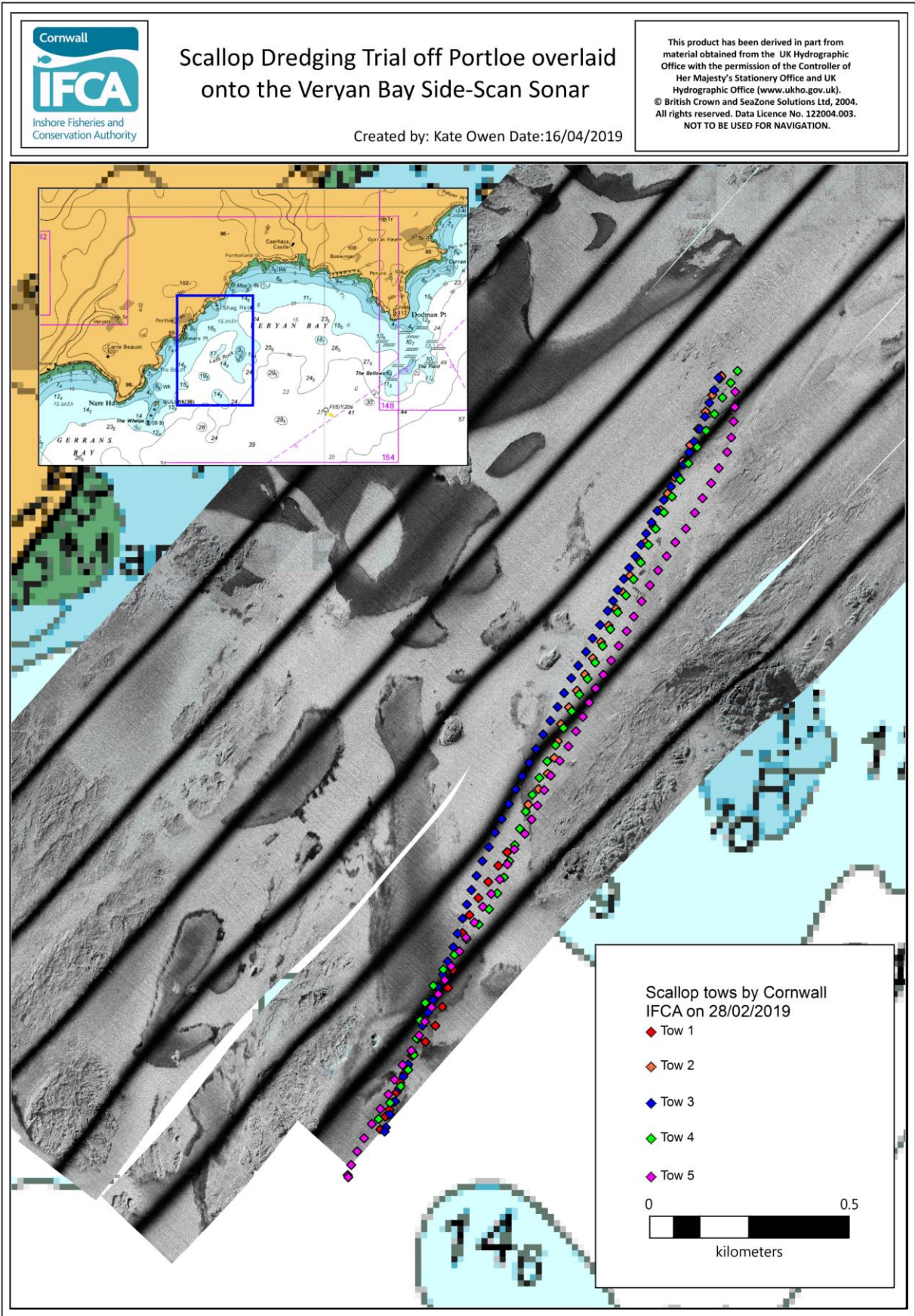


Figure 12: The location of each scallop tow completed by Cornwall IFCA on the 28th February 2019 overlaid onto the side-scan sonar data for Veryan Bay

3.1 Individual tow photographs

The contents of the dredge from each tow are shown below in Table 2.

Table 2: Contents of the dredge from each of the five scallop tows complete in Veryan Bay in February 2019

Tow1	
	
Tow 2	
	
Tow 3	
	



3.2 Scallop results

3.2.1 Scallop measurements

In total 74 scallops were caught during the five tows. The height (mm) of the scallops caught is shown in Figure 13.

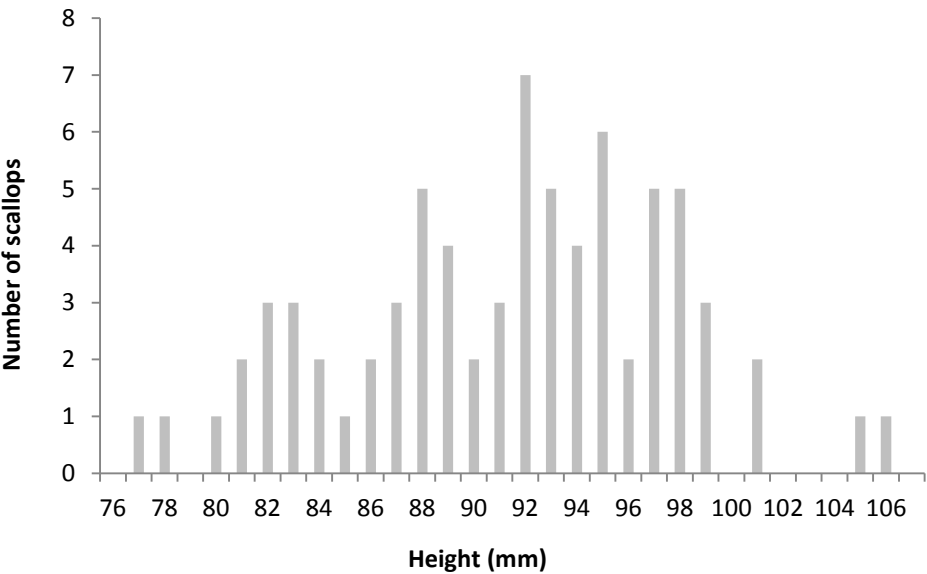


Figure 13: Height (mm) of individual scallops (*Pecten maximus*) collected during the five tows by Cornwall IFCA (n=74).

The width (mm) of the scallops caught is shown in Figure 14. In the Cornwall IFCA District the minimum landing size for king scallops is 100mm (width). Of the 73 scallops measured for width 51 individuals (68.92%) were over this size and could legally be fished, whilst 22 individuals (29.73%) were under the minimum landing size. Scallop height plotted against scallop width is shown in Figure 15.

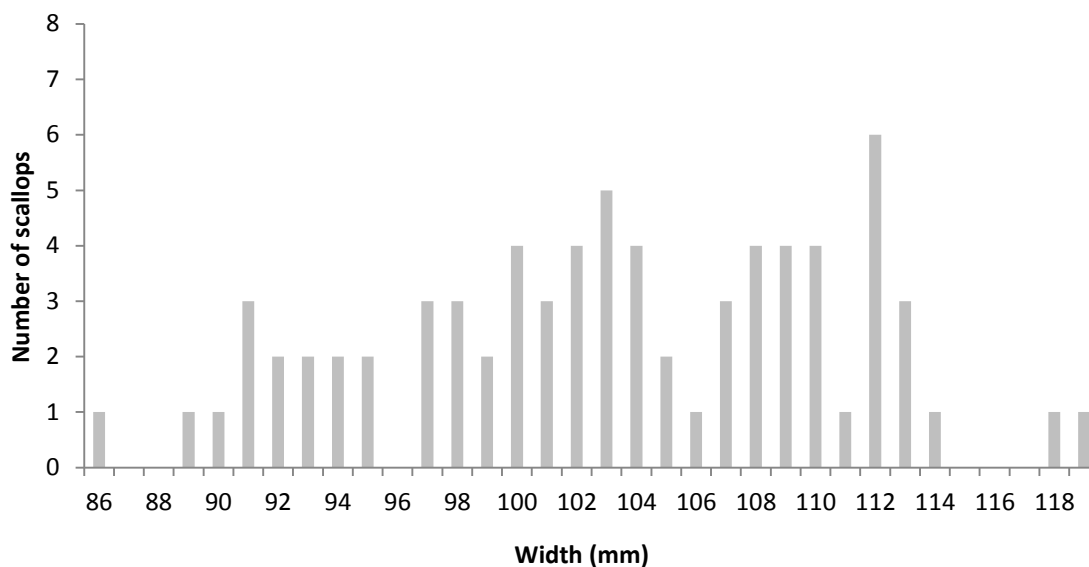


Figure 14: Width (mm) of individual scallops (*Pecten maximus*) collected during the five tows by Cornwall IFCA (n=73).

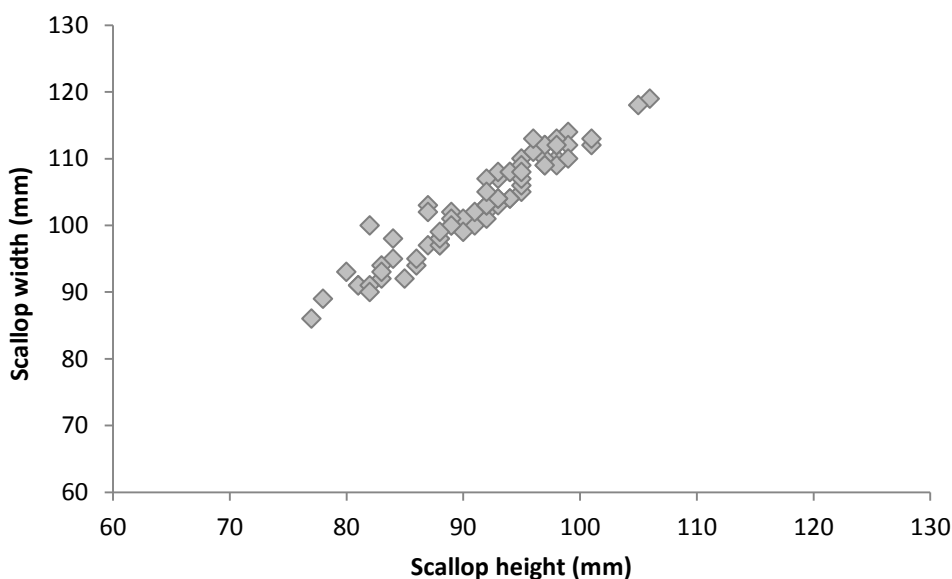


Figure 15: Height (mm) of king scallops (*Pecten maximus*) caught in the five tows by Cornwall IFCA against width (mm). Note - both axes begin at 60mm (n=73).

3.2.2 Age class analysis

The growth ring measurements taken on the 28th February have been corrected after advice from Cefas. Any growth rings which were recorded as 1st year rings, but were 30mm or upwards, have been considered to be 2nd year rings. For example, a 1st year growth ring of 35mm would be corrected to a 2nd year growth ring and each

subsequent ring moved upwards by one year. Individual scallop data (with these corrections applied) is displayed in Annex 3 Table B. Table 3 shows the summary data for scallop age classes in each tow. It should be noted that low confidence was given to the measurements from 9 of the 74 scallops, due to indistinct growth rings on the shell. The number of scallops collected per year class across all five tows is shown in Figure 16.

Table 3: Number of scallops (*Pecten maximus*) from each estimated year class per tow. Please note this data should be taken as a guide only, due to low confidence in some of the shell growth ring measurements. All data has also been corrected for first years growth ring following consultation with Cefas.

Tow	Number of scallops from each (estimated) year class									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	All years
1	-	-	-	1	-	-	-	-	-	1
2	-	-	-	8	7	-	-	-	-	15
3	-	-	2	11	11	2	-	-	-	26
4	-	-	3	9	7	4	-	-	-	23
5	1	-	-	1	4	3	-	-	-	9
Total	1	0	5	30	29	9	0	0	0	74

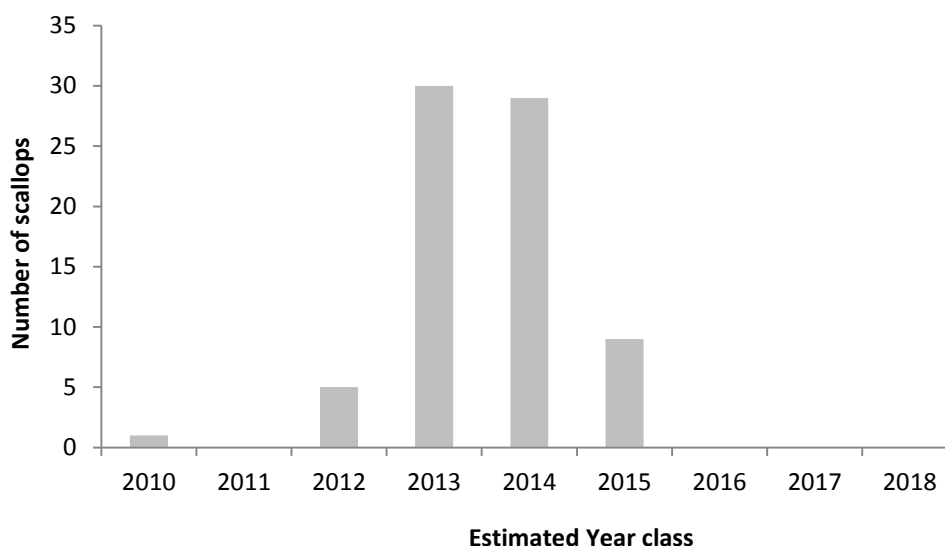


Figure 16: The total number of scallops (*Pecten maximus*) collected from each year class during the five tows by Cornwall IFCA (n=74). Please note this data should be taken as a guide only, due to low confidence in some of the shell growth ring measurements. All data has also been corrected for first year growth ring measurement following advice from Cefas.

3.3 Bycatch

The species most frequently observed as bycatch in the dredges was the spiny starfish (*Marthasterias glacialis*), with at least one seen in each tow. A cuckoo ray (*Leucoraja naevus*) was also caught in the third tow and returned to the sea in good condition Figure 17. Other species seen included the common urchin (*Echinus esculentus*), an unidentified sponge species, keelworms and a chiton on shells, as well as eggs from the common whelk (*Buccinum undatum*).



Figure 17: Cuckoo ray (*Leucoraja naevus*) caught in tow 3 during scallop dredging trials off Portloe on the 28th February

4 Discussion

This survey was a trial for future scallop work to be undertaken by Cornwall IFCA. The trial has shown that the method employed to catch scallops was effective, with the tow bar increasing the efficiency of the dredge from earlier trials. The three repeat tows (Tows 3, 4 and 5) yielded 58 scallops. For future assessments Cornwall IFCA would conduct three or more replicate tows at a number of locations across the district. These would include tows both with and against the tide, as this is considered to have an impact on the catch.

Whilst the method employed was very effective at catching scallops, it can be observed that these were all of a similar size. The smallest scallop height-wise was 77mm and width wise 86mm, due to the mesh size of the dredge bag (100mm). Whilst this dredge survey method will allow analysis of scallops of legal size for the fishery and those likely to enter in the next few years, it will not give an idea of the whole population. In future trials it would be interesting to 'blind' off the dredge for a number of tows to look at the smaller scallops in the population, although the logistics of this are likely to prove complicated.

The current results do not show a clear relationship between the height and width of the scallop shells measured; this could be as a result of the small sample size.

Obtaining measurements for the growth rings of each scallop was generally found to be consistent between Scientific Officers. Discrepancies seemed to occur when identifying the first year's growth ring. There were also a number of scallops where growth rings on the shell were indistinct, making ageing very difficult.

Since this survey was carried out advice has been sought from Cefas regarding growth ring measurement. On future surveys Cornwall IFCA will be measuring scallops from the second growth ring upwards. This is because the first growth ring is not always obvious, sometimes requiring microscopic examination. By measuring from the second growth ring (considered to be the first ring visible more than 30mm from the umbo) any error with the first growth ring can be eliminated. This is likely to provide interesting results when comparing different areas within the district, as growth rate can vary significantly between different regions (Dave Palmer, Cefas – personal comms).

The measurements taken by Cornwall IFCA suggest that the majority of scallops collected in this survey came from the 2013 and 2014 age class. However, due to the low confidence in some measurements and the corrections applied, this should be considered trial data.

5 Recommendations

Recommendations for future surveys include:

1. Conducting a number of tows with the dredge blinded off and assessing the efficiency of this method for the analysis of smaller scallops in the population.
2. Measuring scallops from the second growth ring upwards, removing any error involved with identifying the first growth ring.

6 Acknowledgments

Thanks to Ros McIntyre, Andy Lawler and Dave Palmer from Cefas for their advice on scallop ageing.

7 References

Bell, E., Lawler, A., Masfield, R, McIntyre, R. and Vanstaen, K.R. Initial assessment of Scallop stock status for selected waters within the Channel 2016/2017. Cefas, March 2018.

Cornwall IFCA. Scallop Dredging. Available at: www.cornwall-ifca.gov.uk/scalloping [Accessed 06/03/2019]

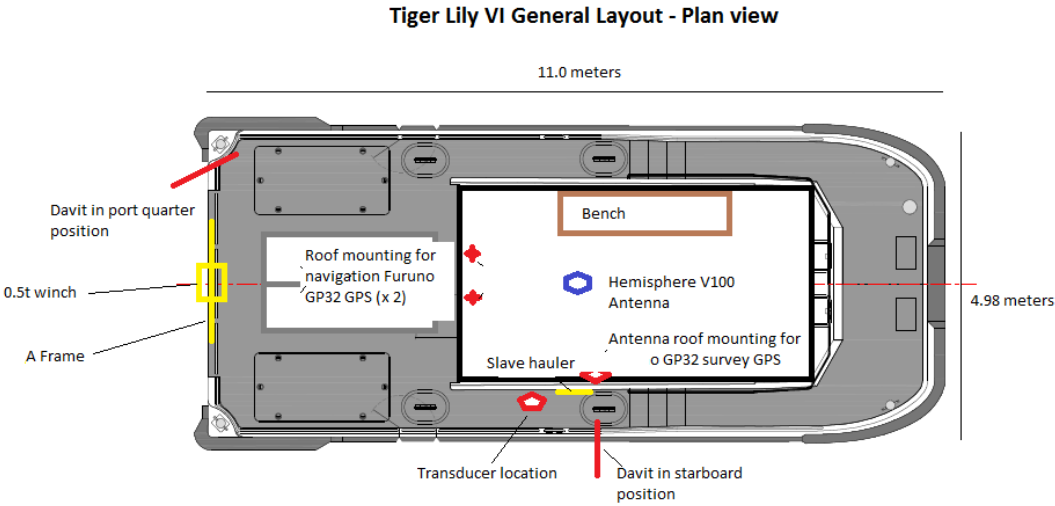
Palmer D. CEFAS. Personal communication following the survey 2019.

8 Appendices

Annex 1 – RV Tiger Lily Deck Plan & 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



Settings

Equipment			Offset (m)		
NMEA Device	Make/Model	Offset Name	X (Forw'd)	Y (Port)	Z (+)
Navigation depth	Furuno Navnet	Furuno transducer	5.5	0.75	-0.5
Survey GPS	Furuno GP32	Furuno mushroom antenna	4.8	1.0	

Annex 2 – Daily Log

Annex Table A: Daily log from R/V Tiger Lily 28th February 2019

Project information			
Project	Scallop dredging trials in Veryan Bay		
Survey code	190228_CIFCA_Scallop_Trials_Portloe		
Location	Portloe, Veryan Bay		
Date	28 th February 2019		
Vessel	R/V Tiger Lily		
Staff			
Survey role	Company	Name	
Principal Scientific Officer	Cornwall IFCA	Colin Trundle	
Scientific Officer	Cornwall IFCA	Annie Jenkin	
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon	
Scientific Officer	Cornwall IFCA	Kate Owen	
Skipper	Independent	David Raymond	
Weather and tides			
High water time:	12:00		
High water (m)	3.8		
Wind direction	West	West	
Wind speed	23mph (gusting 33)	23mph (gusting 33)	
Beaufort scale	7-8	7-8	
Cloud coverage	8/8	6/8	
Time weather recorded	08:08	12:00	
Safety			
Toolbox talk time	08:25		
Induction	08:20		
Summary of operations			
Time start (UTC)	Time end (UTC)	Type	Activity
08:45	09:19	Vessel movement	R/V Tiger Lily departs Mylor for Portloe
09:34	09:44	Fishing	Dredge tow 1
10:00	10:13	Fishing	Dredge tow 2
10:27	10:56	Fishing	Dredge tow 3
11:20	11:43	Fishing	Dredge tow 4
12:04	12:31	Fishing	Dredge tow 5
13:00	13:45	Vessel movement	Transit to calmer water for lunch
13:45	14:15	Vessel movement	R/V Tiger Lily leaves Portloe and transits to Mylor
Overall progress			
Action	Tows completed		
Dredge tows	5		

Annex 3 - Scallop Field Data

Annex Table B: Scallop measurement data collected by Cornwall IFCA on the 29th February 2019. NB all data has been corrected for the first year's growth ring following advice from Cefas

Tow	No. of rings	Estimated Age	Estimated Year class	Shell Height (mm)	Growth ring measurements (mm)								Shell Width (mm)	Comments	Measurement confidence	Corrected for first ring	Total per tow
					1st	2nd	3rd	4th	5th	6th	7th	8th					
1	5	6	2013	98	-	47	64	73	91				110		High	Y	1
2	4	5	2014	97	-	32	65	88					112		High	Y	
2	5	6	2013	95	-	30	62	82	94				110		High	Y	
2	4	5	2014	93	-	35	71	86					107		High	Y	
2	5	6	2013	92	-	42	57	81	88				102		High	Y	
2	5	6	2013	97	-	31	61	79	92				110		High	Y	
2	4	5	2014	95	25	57	81	92					105		High	N	
2	4	5	2014	93	21	61	79	90					108		High	N	
2	5	6	2013	97	-	33	65	82	91				109		High	Y	
2	4	5	2014	89	21	53	65	78					100	Rings indistinct	Low	N	
2	4	5	2014	91	28	58	70	88					100	Rings indistinct	Low	N	
2	4	5	2014	88	-	32	64	81					97	Rings indistinct	Low	Y	
2	5	6	2013	88	-	34	62	74	84				98		High	Y	
2	5	6	2013	84	-	34	51	69	81				95		High	Y	
2	5	6	2013	87	-	35	61	78	81				97		High	Y	
2	5	6	2013	84	-	32	53	61	75				98	Rings indistinct	Low	Y	15
3	5	6	2013	94	-	35	68	85	91				108		High	Y	
3	6	7	2012	99	-	30	54	79	91	95			114		High	Y	
3	4	5	2014	92	-	32	61	82					101		High	Y	
3	5	6	2013	95	-	30	56	80	91				109		High	Y	
3	5	6	2013	87	-	35	53	68	84				103		High	Y	
3	5	6	2013	98	20	53	72	89	94				112		High	N	
3	5	6	2013	92	-	35	59	80	91				107		High	Y	
3	5	6	2013	95	-	30	56	82	93				106		High	Y	
3	3	4	2015	95	26	62	86						107		High	N	
3	5	6	2013	101	21	50	61	80	93				112		High	N	

Tow	No. of rings	Estimated Age	Estimated Year class	Shell Height (mm)	Growth ring measurements (mm)								Shell Width (mm)	Comments	Measurement confidence	Corrected for first ring	Total per tow
					1st	2nd	3rd	4th	5th	6th	7th	8th					
3	5	6	2013	91	-	32	62	78	87				102		High	Y	
3	4	5	2014	98	16	51	82	95					109		High	N	
3	4	5	2014	82	-	32	61	80					100		High	Y	
3	4	5	2014	93	27	60	79	89					103		High	N	
3	5	6	2013	97	-	30	62	83	94				109		High	Y	
3	6	7	2012	106	-	32	61	81	92	99			119		High	Y	
3	4	5	2014	87	-	40	49	75					102	Rings indistinct	Low	Y	
3	4	5	2014	89	-	30	56	79					102	Rings indistinct	Low	Y	
3	4	5	2014	90	28	40	61	82					101		High	N	
3	5	6	2013	88	-	32	53	65	78				97		High	Y	
3	4	5	2014	83	-	34	68	81					92		High	Y	
3	4	5	2014	86	11	38	67	82					94		High	N	
3	4	5	2014	80	-	32	60	77					93		High	Y	
3	3	4	2015	81	22	61	77						91		High	N	
3	5	6	2013	90	-	34	48	63	83				99	Rings indistinct	Low	Y	
3	4	5	2014	83	-	33	69	82					94		High	Y	26
4	6	7	2012	99	-	38	53	80	90	99			112		High	Y	
4	5	6	2013	98	-	37	66	81	90				113		High	Y	
4	4	5	2014	99	28	62	82	95					110		High	N	
4	5	6	2013	92	23	49	62	80	89				103		High	N	
4	5	6	2013	94	-	30	60	81	90				108		High	Y	
4	5	6	2013	97	27	64	74	89	94				112		High	N	
4	3	4	2015	94	26	60	87						104		High	N	
4	5	6	2013	101	17	41	82	90	96				113	Rings indistinct	Low	N	

Tow	No. of rings	Estimated Age	Estimated Year class	Shell Height (mm)	Growth ring measurements (mm)								Shell Width (mm)	Comments	Measurement confidence	Corrected for first ring	Total per tow
					1st	2nd	3rd	4th	5th	6th	7th	8th					
4	6	7	2012	94	-	30	51	64	82	89			104		High	Y	
4	6	7	2012	92	-	35	45	64	73	87			103		High	Y	
4	4	5	2014	93	25	59	81	90					104		High	N	
4	5	6	2013	92	-	31	62	83	90				103		High	Y	
4	5	6	2013	96	-	30	58	86	93				111		High	Y	
4	5	6	2013	93	-	34	61	82	91				104		High	Y	
4	4	5	2014	89	26	58	78	85					101		High	N	
4	5	6	2013	92	-	31	61	80	90				105		High	Y	
4	3	4	2015	81	-	30	69						91		High	Y	
4	4	5	2014	83	-	30	58	78					93		High	Y	
4	4	5	2014	88	-	41	52	74					98		High	Y	
4	4	5	2014	86	-	30	62	80					95		High	Y	
4	4	5	2014	89	22	48	56	78					100		High	N	
4	3	4	2015	82	26	59	78						91	Rings indistinct	Low	N	
4	3	4	2015	85	19	45	79						92		High	N	23
5	5	6	2013	95	18	21	50	64	78				108		High	N	
5	3	4	2015	98	17	63	94						112	Rings indistinct	Low	N	
5	4	5	2014	96	18	30	60	84					113		High	N	
5	4	5	2014	88	-	31	67	85					99		High	Y	
5	8	9	2010	105	20	29	61	91	94	98	101	104	118		High	N	
5	4	5	2014	78	-	32	63	76					89		High	Y	
5	3	4	2015	91	28	61	78						not sized		High	N	
5	4	5	2014	82	17	30	42	70					90		High	N	
5	3	4	2015	77	24	54	72						86		High	N	9