



## Multi-year intertidal Edible Crab (*Cancer pagurus*) survey 2021-2023



Final report for the 2021-2023 Intertidal Edible Crab Survey  
(2021-2023\_CIFCA\_GRE\_INT\_EDC)

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA)

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## **Glossary of Terms and abbreviations**

BST	British Summer Time
Cefas	Centre for Environment, Fisheries and Aquaculture Science
EOL	End of line
IFCA	Inshore Fisheries and Conservation Authority
SAC	Special Area of Conservation
SOL	Start of line
UTC	Universal Time Coordinated



## 1 Introduction

Cornwall Inshore Fisheries and Conservation Authority (IFCA) has been investigating ways to survey the abundance of edible crab (*Cancer pagurus*), also known as brown crab, within the Cornwall IFCA district. Shallow water, cobble nursery habitats are likely to represent a major source of recruitment to offshore fisheries (Robinson and Tully, 2000). In 2012, the Centre for Environment, Fisheries and Aquaculture Science (Cefas), carried out a shoreline survey to sample juvenile edible crab in Cornwall. The survey was carried out to examine the feasibility of shore-based sampling of juvenile edible crabs and the utility of the data collected as an abundance index, a source of information on crab growth and further analysis of length frequency data (Smith, 2012a and 2012b). Since then, two masters students have carried out separate studies: O'Halloran (2015) looked at the nursery function of rockpools for commercially important species of crab, *C. pagurus*, velvet swimming crab (*Necora puber*) and Spider Crab (*Maja squinado*) in Jersey and Heraghty (2013) investigated the abundance, distribution and habitat use of juvenile *C. pagurus* of the intertidal zone around Anglesey and Llŷn Peninsula, North Wales (UK).

Juvenile edible crabs, *C. pagurus* settle from July to September (Robinson and Tully, 2000) and inhabit the intertidal zone until they reach a carapace width of 60-70mm before they migrate to subtidal areas offshore after around three years (Robinson and Tully, 2000). The subtidal migration pattern varies between the sexes. Males have been observed migrating large distances, especially larger, older animals, but generally they are nomadic and move in fairly random localised patterns. Females move offshore to spawn then back inshore to mate and feed (Hunter *et al.*, 2013). Mark and recapture studies have shown females in the English Channel travel on a westward axis. It is suggested that this western travel is a migration to spawning grounds, allowing the edible crab larvae to hatch and travel in the prevailing tidal currents returning them to settle in areas of their mother's origin (Hunter *et al.*, 2013).

In 2020, Cornwall IFCA carried out two exploratory survey days at Prisk Cove, near Mawnan Smith on the south coast of Cornwall. This site was chosen due to high records of edible crab numbers during past Seasearch surveys (Matt Slater, pers. comm. 2020). These two surveys trialled different sampling methods: one using a 5 m<sup>2</sup> grid at different stages down the shoreline from the high-water mark to the low water mark and the other doing a walkover along the length of shore at the low water mark parallel to the shoreline. The walkover method proved more suitable to the survey and has been used by Cornwall IFCA in subsequent surveys presented in this report. Due to the low numbers of edible crabs at the Prisk Cove site from the two preliminary survey days, it was decided that repeating the survey at Greeb Point, Portscatho which is the location Cefas used for their surveys would be more beneficial.

Edible crabs are known to live in a wide range of habitats, from coarse to muddy sand, gravel and bedrock, under boulders and shingles and females prefer softer sandy substrates (FAO, 2021). The site at Portscatho provides optimal habitat and shelter for juvenile edible crabs consisting of coarse sand, pebbles, cobbles, boulders and bedrock with overhangs. In 2021, the survey area at Greeb Point was surveyed by Vertical

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Horizons Media using a UAV and a high-resolution mosaic of the image data collected was created to accurately show the habitat.

This report summarised the results from exploratory multiyear intertidal edible crab surveys, between 2021 and 2023, conducted at Greeb Point.

## 1.1 Aims and objectives

### 1.1.1 Aims

- To investigate the abundance of edible crab (*C. pagurus*) at Greeb point, located on the south coast of Cornwall, between 2021 and 2023.
- To use the Greeb point site to optimise Intertidal crab survey methodology.
- To create a tool that could be used in future to investigate the use of intertidal crab surveys as a proxy monitoring crab abundance, and in turn potentially a recruitment index for edible crab fisheries in the future.

### 1.1.2 Objectives

- To photograph, measure and record the length (mm) of all edible crabs (*C. pagurus*) observed during the sampling period and compare results between years.
- To provide information on growth increment where moults were present with soft shelled specimens.
- To record any invasive species observed during the survey.
- To provide recommendations for future survey work.

## 2 Methodology

### 2.1 Survey location

The survey was carried out at Greeb Point, one mile south of Portscatho on the south coast of Cornwall. This location was sampled by Cefas in 2012 and provides an ideal habitat for juvenile edible crab. It comprises a rocky outcrop with gullies that are full of a mixture of coarse sand, stones, cobbles and small boulders (Figure 1). The location is accessed down a narrow, overgrown path and is therefore exposed to minimal human disturbance, as it is off the main coastal path. The survey site is situated within the Fal and Helford Special Area of Conservation (SAC).



Figure 1: Survey site at Greeb Point on the south coast of Cornwall.

## 2.2 Survey timing

The survey was carried covering as much ground as possible in up to a 2 hour 15 minute window around the predicted spring low tide time between April 2021 and June 2023. Cornwall IFCA carried out eleven survey days (between: April to October in 2021, March to July in 2022 and March to June in 2023) to sample juvenile edible crabs at Greeb Point (Table 1). Timings of later year surveys were modified accordingly to account for findings from previous years surveys, to allow sampling when the crabs at the site were most abundant. Data from the 2021 and 2022 surveys has previously been reported by Cornwall IFCA (Jenkin *et al.*, 2021 and 2023). Further detail on individual surveys can be found in Annex 1.

Table 1: Cornwall IFCA 2021 to 2023 Intertidal edible crab survey dates.

Year	Month	Date
2021	April	29 <sup>th</sup> April 2021
2021	May	27 <sup>th</sup> May 2021
2021	June	23 <sup>rd</sup> June 2021
2021	October	8 <sup>th</sup> October 2021
2022	March	3 <sup>rd</sup> March 2022
2022	March	31 <sup>st</sup> March 2022
2022	June	15 <sup>th</sup> June 2022
2022	July	14 <sup>th</sup> July 2022
2023	March	21 <sup>st</sup> March 2023
2023	April	20 <sup>th</sup> April 2023
2023	June	5 <sup>th</sup> June 2023

### 2.3 Personnel

The survey was carried out by two scientific officers (apart from the surveys on 27<sup>th</sup> May 2021 [one scientific officer] and 21<sup>st</sup> March 2023 [three officers]).

### 2.4 Personal Protective Equipment (PPE)

Steel toe capped boots were worn while carrying out the surveys. Waterproofs, suncream and sunhats were used as required. A first aid kit and mobile phone were in possession of the officers at all times. There were no reported accidents or near misses during the survey.

### 2.5 Survey methodology

The start of line (SOL) positions from the survey carried out by Cefas in 2012 was used as the SOL position in the Cornwall 2021, 2022 and 2023 surveys. The end of line (EOL) position was modified for all surveys from 2022 onwards due to time constraints and habitat type which consisted mainly of bedrock with overhangs which made it hard to record edible crabs. Positions were loaded into a handheld Garmin GPS 60 unit using latitude and longitude and work mobile phones using the what3words app. All times were recorded as Universal Time Coordinated (UTC) unless otherwise stated.

Officers initially recorded the weather and tide times into a log sheet (water temperature was also recorded for 2023 surveys) and then proceeded to the SOL position. Officers walked towards the EOL position covering as much ground as possible. At the given survey positions, stones, cobbles and boulders that were deemed safe (not too heavy or in an awkward position) were overturned and checked for edible crabs hiding underneath.

If crabs were found, these were picked up carefully and their abdomen was photographed with an Olympus Tough TG-5 or an Olympus Tough TG-6. The crabs were measured across the width of the carapace (mm) using vernier callipers and carapace width recorded on a log sheet. Determining the gender of immature edible crab is difficult as the differences in the abdominal flaps are not as distinct as in adult edible crabs (personal pre survey observation). As such crab gender was recorded as U (unsexed) for crabs <60MM carapace width and recorded as either male or female if they were ≥60mm and morphological features allowed a clear gender assignment. Once measured, the crabs were returned to the place they were found and the habitat was returned to as found, by replacing stones and cobbles to their original positions.

### 2.6 Data handling

Data was entered into a daily log sheet and then transferred to Microsoft Excel. All photographs taken during the survey were transferred to Cornwall IFCA's servers.

### 2.7 Data analysis

The survey metadata, GPS positioning and crab data were transferred into Excel. Length frequency and density, box and dot plots were created in R (using R studio version 4.3.2) to visualise trends in data. However given the exploratory nature of this work the survey results have been compared with caution.

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The GPS track for all survey days were plotted using MapInfo Professional Advanced (Version 17.0.4) over aerial footage from drone photography of the survey site supplied by Vertical Horizons Media and was used as a base layer for surveys positional data.

### 3 Results

Eleven 2021 to 2023 intertidal edible crab surveys were carried out between March 2021 and June 2023 (Table 1). The daily survey logs are shown in Annex 1.

Given the exploratory nature of these surveys in determining the optimum intertidal crab survey protocol (in terms of time of year and sampling frequency) each year saw differing months surveyed (visualised in Table 2). Four surveys were conducted in both 2021 and 2022 and three surveys in 2023.

Table 2: Visual spread of Intertidal crab surveys over 2021, 2022 and 2023. \* Note the April survey representation in 2022 denotes a survey taken on the 31<sup>st</sup> March 2022.

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2021				X	X	X				X		
2022			X	X		X	X					
2023			X	X		X						

#### 3.1 Survey Narrative

All times are Universal Time Coordinated (UTC) unless stated otherwise.

##### 3.1.1 2021

###### 29<sup>th</sup> April 2021

The weather conditions were favourable with light winds from the NW of 10 mph and overcast skies with cloud coverage of 8/8. Cornwall IFCA officers arrived on site at 11:15 and did a short recce before the survey commenced to see what habitat the edible crabs could be found and to locate the position that Cefas had carried out their previous survey. During the recce a large number of edible brown crabs were discovered so the survey started earlier than planned at 11:55. The survey ended at 14:13 and IFCA officers departed the site at 14:45. Low tide on the day was 0.14 m at 13:15 as recorded in Falmouth (UTC). 65 brown crabs were recorded as part of the survey.

###### 27<sup>th</sup> May 2021

The weather conditions were favourable with light winds from the SSE of 10-14 mph and partially overcast skies with cloud coverage of 5/8. A Cornwall IFCA officer arrived on site at 11:45 and started the survey at 11:48. The

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survey ended at 13:31 and IFCA officer departed the site at 13:45. Low tide on the day was 0.25 m at 12:15 as recorded in Falmouth (UTC). 37 brown crabs were recorded as part of the survey. A noticeable increase in velvet swimming crabs and Montagu's crab was observed compared to the previous survey.

**23<sup>rd</sup> June 2021**

The weather conditions were favourable with light winds from the NE of 6-10 mph and sunny skies with low cloud coverage of 1/8. Cornwall IFCA officers arrived on site at 09:25 and started the survey at 09:37. The survey ended at 11:23 and IFCA officers departed the site at 11:55. Low tide on the day was 0.72 m at 10:11 as recorded in Falmouth (UTC). 35 brown crabs were recorded as part of the survey. A noticeable increase in algae coverage over rocks, Montagu's crabs more abundant and larger velvet swimming crabs.

**8<sup>th</sup> October 2021**

The weather conditions were favourable with light winds from the SE of 10-13 mph and sunny skies with low cloud coverage of 1/8. Cornwall IFCA officers arrived on site at 11:55 and started the survey at 12:17. The survey ended at 14:27 and IFCA officers departed the site at 14:40. Low tide on the day was 0.29 m at 12:49 as recorded in Falmouth (UTC). 18 brown crabs were recorded as part of the survey. A noticeable increase in brown algae coverage over rocks.

**3.1.2 2022****3<sup>rd</sup> March 2022**

The weather conditions were favourable with moderate winds from the NW of 17 to 25 mph and overcast skies with cloud coverage of 6/8. Cornwall IFCA officers arrived on site at 11:55 and started the survey at 12:01. The survey ended at 13:44 and IFCA officers departed the site at 14:10. Low tide on the day was 0.10 m at 12:30 as recorded in Falmouth (UTC). 43 brown crabs were recorded as part of the survey.

**31<sup>st</sup> March 2022**

The weather conditions were unfavourable with a strong, cold ENE wind of 20 to 35 mph blowing across the survey site making it hard to see in some of the rockpools. The skies were mostly clear with cloud coverage of 3/8. Cornwall IFCA officers arrived on site at 11:00 and started the survey at 11:14. The survey ended at 12:43 and IFCA officers departed the site at 13:15. Low tide on the day was 0.56 m at 11:26 as recorded in Falmouth (UTC). 56 brown crabs were recorded as part of the survey.

**15<sup>th</sup> June 2022**

The weather conditions were favourable with light winds from the NW of 10 mph and mostly clear skies with low cloud coverage of 3/8. Cornwall IFCA officers arrived on site at 11:30 and started the survey at 11:43. The survey ended at 13:22 and IFCA officers departed the site at 13:35. Low tide on the day was 0.49 m at 12:11 as recorded in Falmouth (UTC). 41 brown crabs were recorded as part of the survey. There was a noticeable increase in green algal coverage over rocks since the last survey.

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**14<sup>th</sup> July 2022**

The weather conditions were favourable with moderate winds from N of 20 mph and sunny skies with low cloud coverage of 1/8. Cornwall IFCA officers arrived on site at 10:50 and started the survey at 11:03. The survey ended at 12:47 and IFCA officers departed the site at 13:25. Low tide on the day was 0.58 m at 12:04 as recorded in Falmouth (UTC). 29 brown crabs were recorded as part of the survey. The green algal cover found on the 15<sup>th</sup> June was still present on the rocks.

**3.1.3 2023****21st March 2023**

The weather conditions were favourable with moderate winds from SW of 17-23 mph and overcast with high cloud coverage of 7/8. Cornwall IFCA officers arrived on site at 10:40 and started the survey at 10:54. The survey ended at 12:47 and IFCA officers departed the site at 13:10. Low tide on the day was 0.10 m at 11:40 as recorded in Falmouth (UTC). 35 live brown crabs were recorded as part of the survey (plus two dead specimens and four empty carapaces).

**20th April 2023**

The weather conditions were favourable with moderate/high winds from E of 15-30 mph and mostly clear skies with low cloud coverage of 2/8. Cornwall IFCA officers arrived on site at 10:24 and started the survey at 10:59. The survey ended at 12:41 and IFCA officers departed the site at 13:10. Low tide on the day was 0.09 m at 11:58 as recorded in Falmouth (UTC). 46 live brown crabs were recorded as part of the survey. A lot more sand and stones were noticeable at survey site after strong winds. Underside of some rocks looked cleaner e.g. less keel worms.

**5th June 2023**

The weather conditions were favourable with moderate winds from E of 11-15 mph and clear sunny skies with low cloud coverage of 1/8. Cornwall IFCA officers arrived on site at 10:50 and started the survey at 11:23. The survey ended at 12:54 and IFCA officers departed the site at 13:21. Low tide on the day was 0.65 m at 12:21 as recorded in Falmouth (UTC). 34 live brown crabs were recorded as part of the survey. Increase in algae coverage in area - wracks and *Sargassum* spp.

**3.1.4 Survey location**

The start of line and end of line positions (WGS 84) are shown in Table 3.

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Table 3: Positions of the start of line (SOL) and end of line (EOL) for each of the survey days in 2022.

Date	SOL position		EOL position	
	Latitude (dd.dddddd)	Longitude (dd.dddddd)	Latitude (dd.dddddd)	Longitude (dd.dddddd)
<b>2021</b>				
29 <sup>th</sup> April 2021	50.164500	-4.972300	50.165050	-4.972050
27 <sup>th</sup> May 2021	50.164250	-4.972283	50.164483	-4.972350
23 <sup>rd</sup> June 2021	50.164233	-4.972250	50.165417	-4.972350
8 <sup>th</sup> October 2021	50.164250	-4.972233	50.164567	-4.972550
<b>2022</b>				
3 <sup>rd</sup> March 2022	50.164250	-4.972250	50.164467	-4.972233
31 <sup>st</sup> March 2022	50.164250	-4.972300	50.164550	-4.972467
15 <sup>th</sup> June 2022	50.164250	-4.972267	50.164500	-4.972433
14 <sup>th</sup> July 2022	50.164133	-4.972317	50.164533	-4.972483
<b>2023</b>				
21 <sup>st</sup> March 2023	50.164267	-4.972317	50.164517	-4.972400
20 <sup>th</sup> April 2023	50.164250	-4.972300	50.164433	-4.972267
5 <sup>th</sup> June 2023	50.164433	-4.972333	50.164267	-4.972250

The GPS SOL, EOL positions and the track for each survey day are shown in Figure 2 to Figure 12.



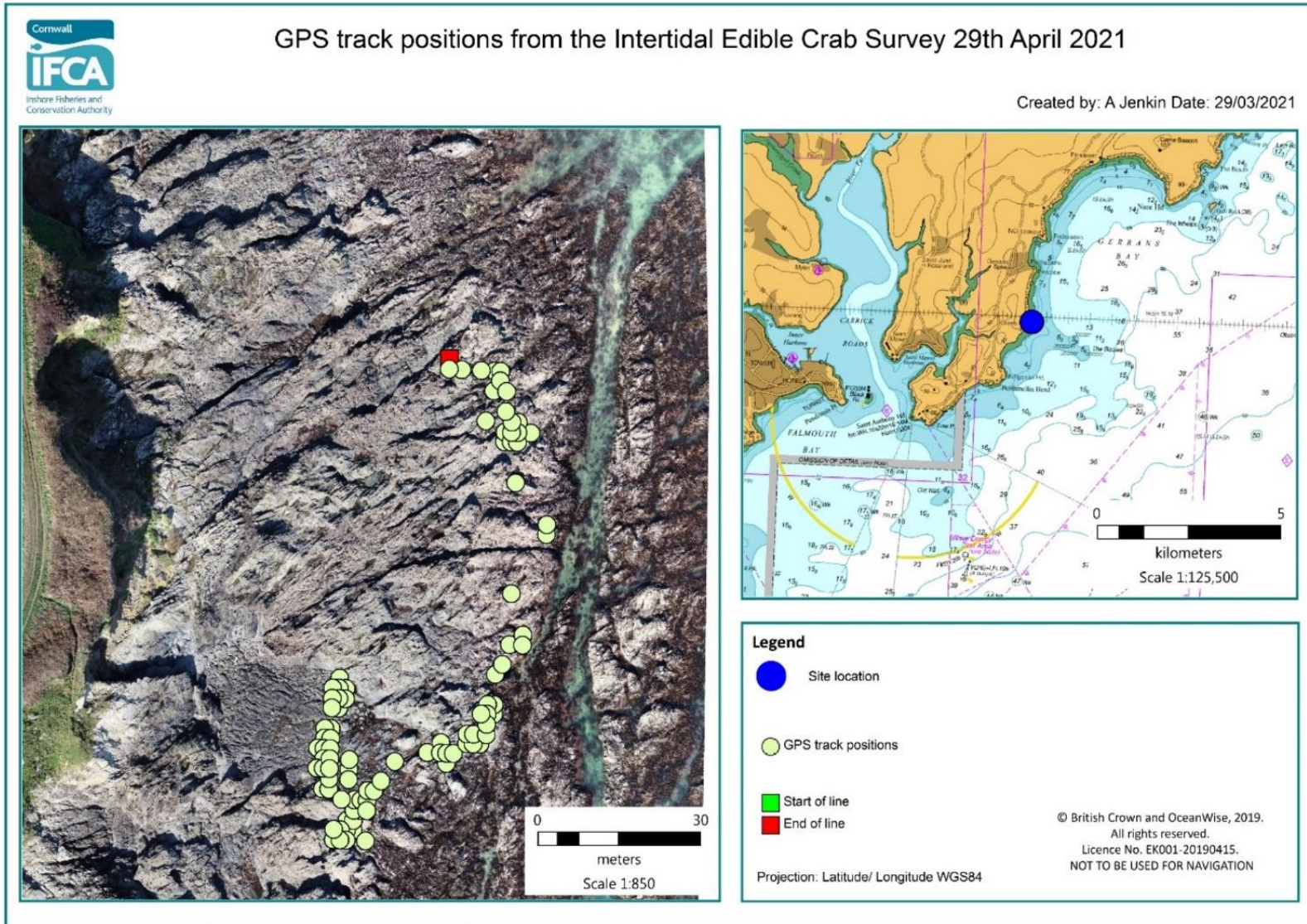


Figure 2: GPS track points from the intertidal survey on 29th April 2021.



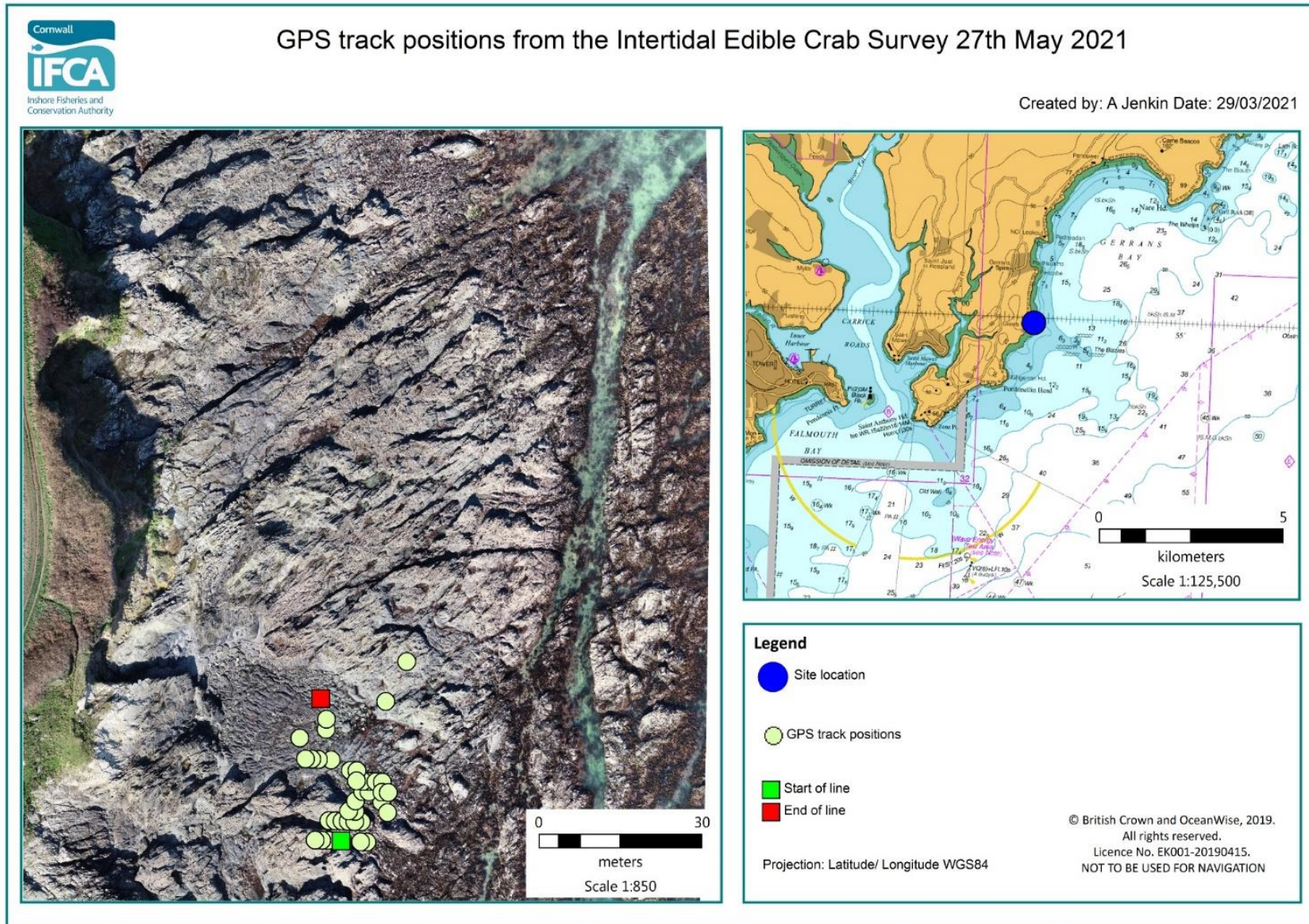


Figure 3: GPS track points from the intertidal survey on 27th May 2021.



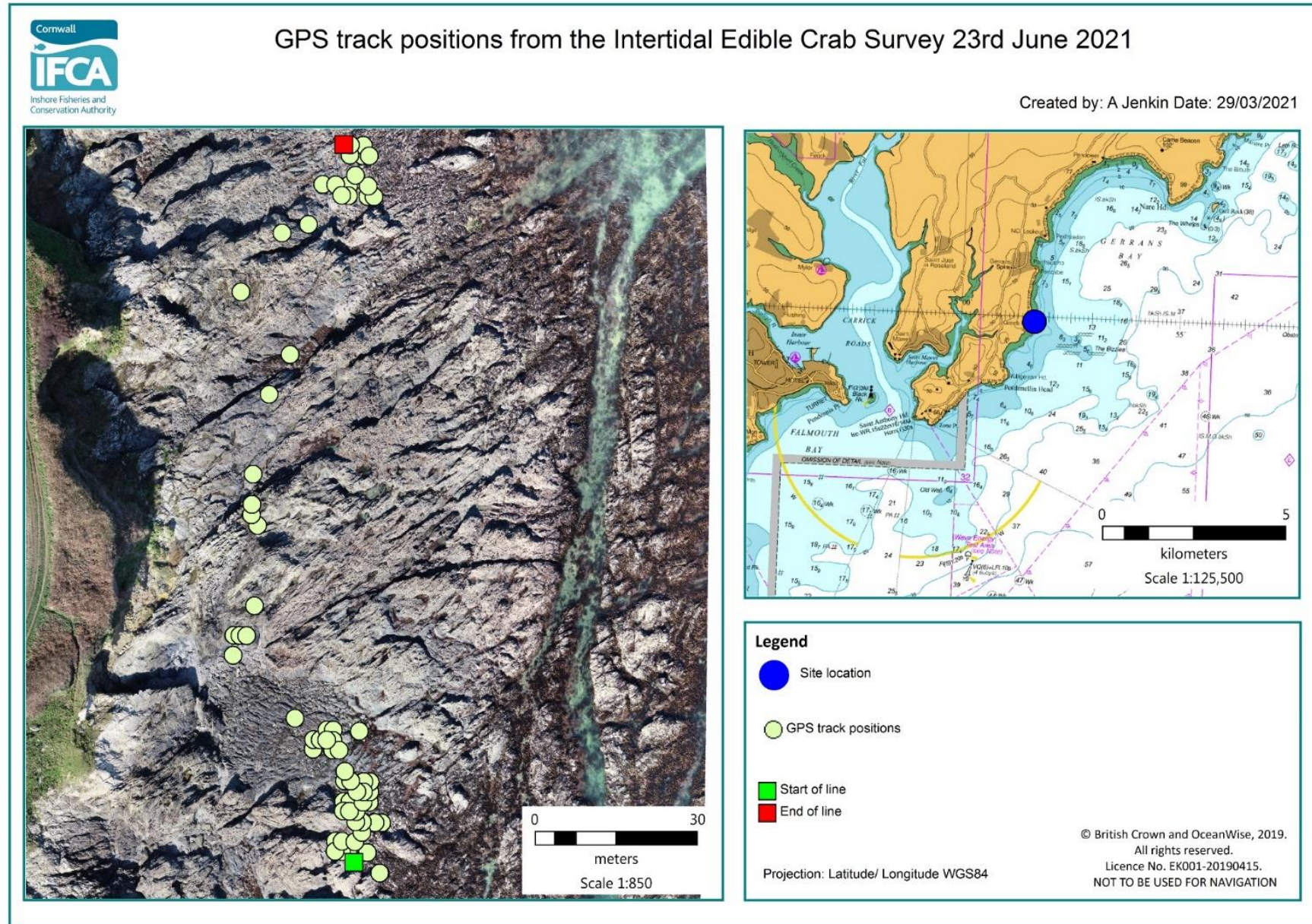


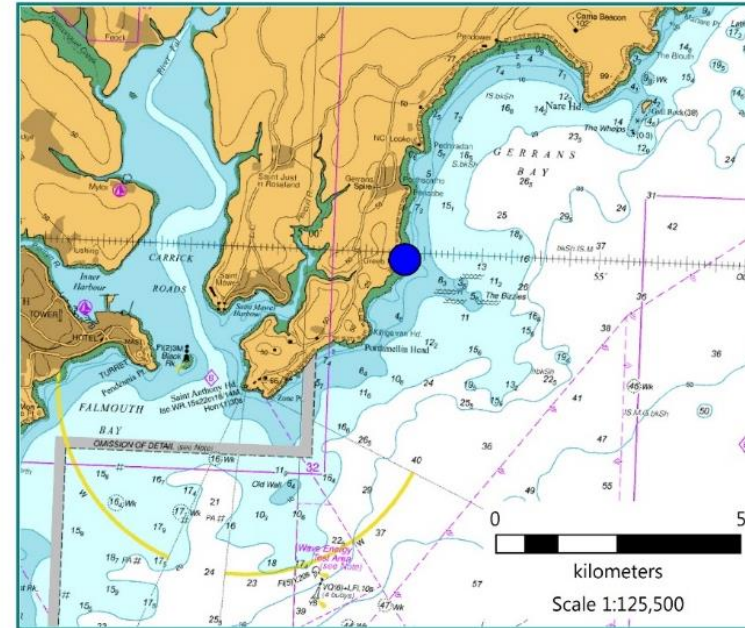
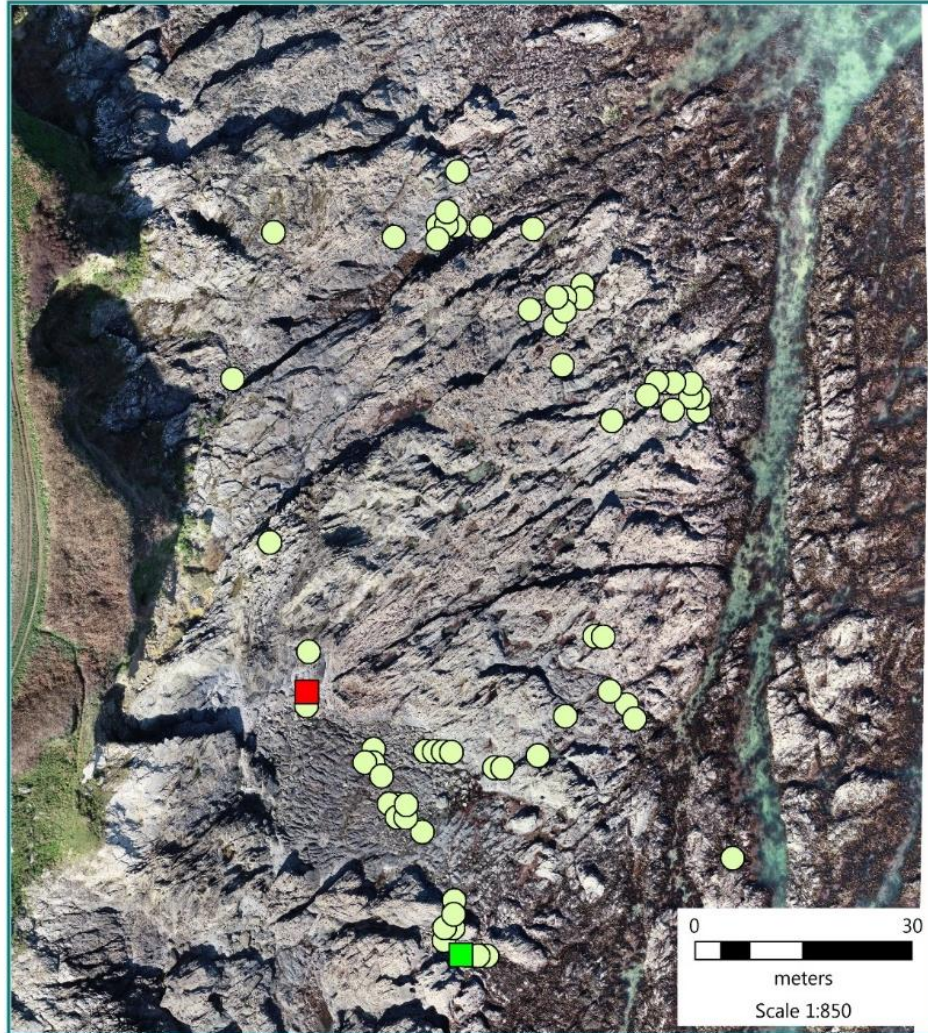
Figure 4: GPS track points from the intertidal survey on 23rd June 2021.





# GPS track positions from the Intertidal Edible Crab Survey 8th October 2021

Created by: A Jenkin Date: 29/03/2021



**Legend**

- Site location
- GPS track positions
- Start of line
- End of line

Projection: Latitude/ Longitude WGS84

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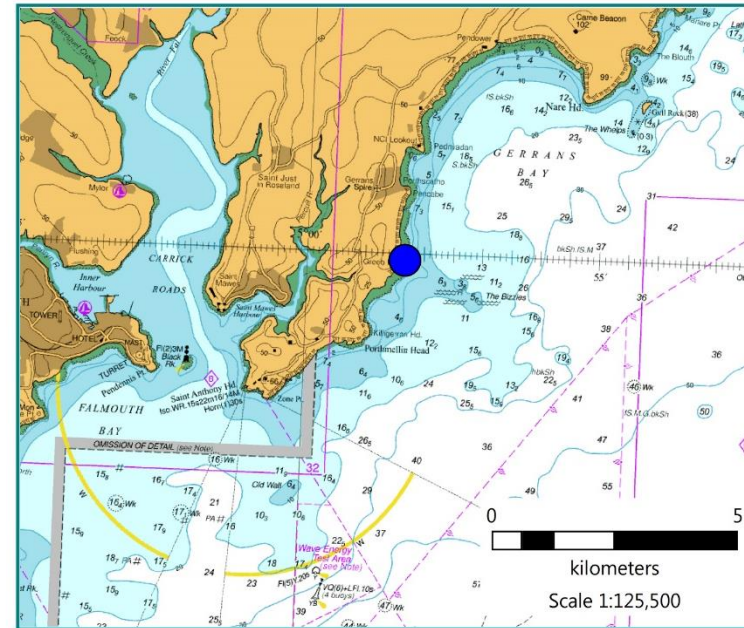
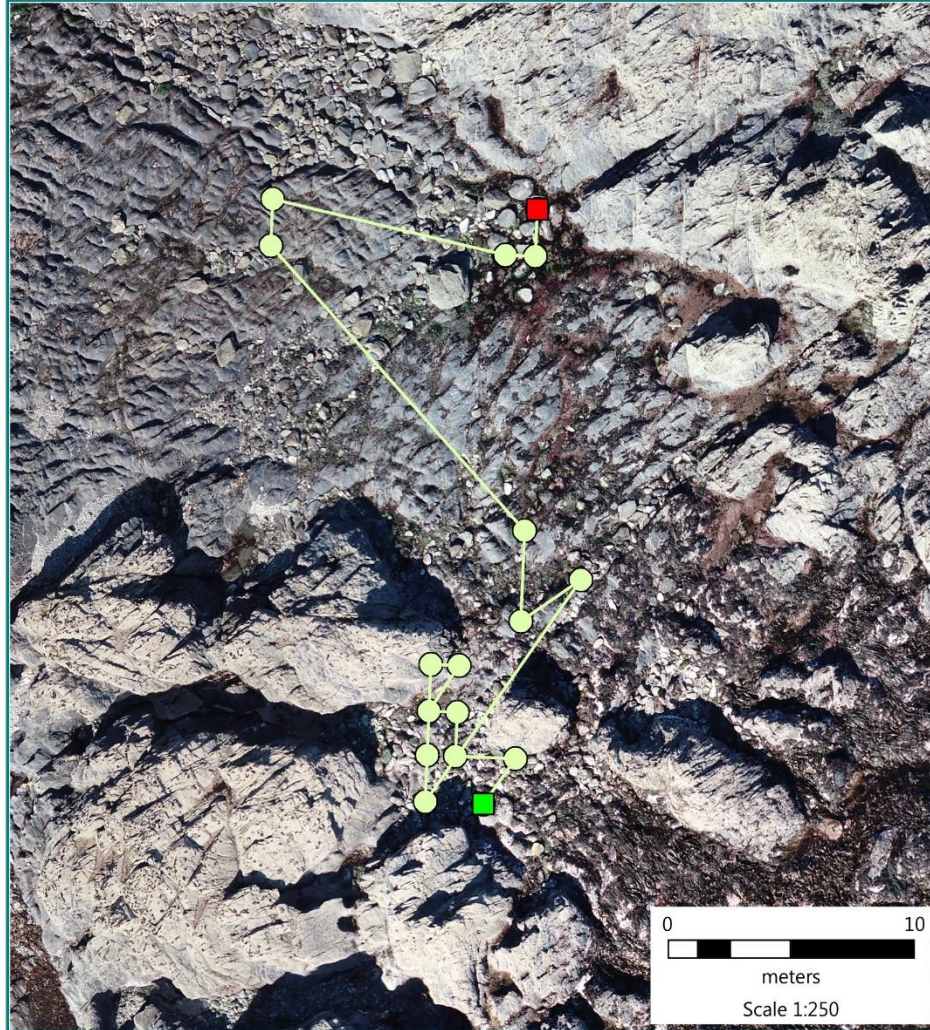
Figure 5: GPS track points from the intertidal survey on 8th October 2021.





# GPS track positions from the Intertidal Edible Crab Survey 3rd March 2022

Created by: A Jenkin/ C Daniels Date: 15/12/2022



**Legend**

- Site location
- GPS track positions
- GPS track
- Start of Line
- End of Line

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NOT TO BE USED FOR NAVIGATION

Projection: Latitude/ Longitude WGS84

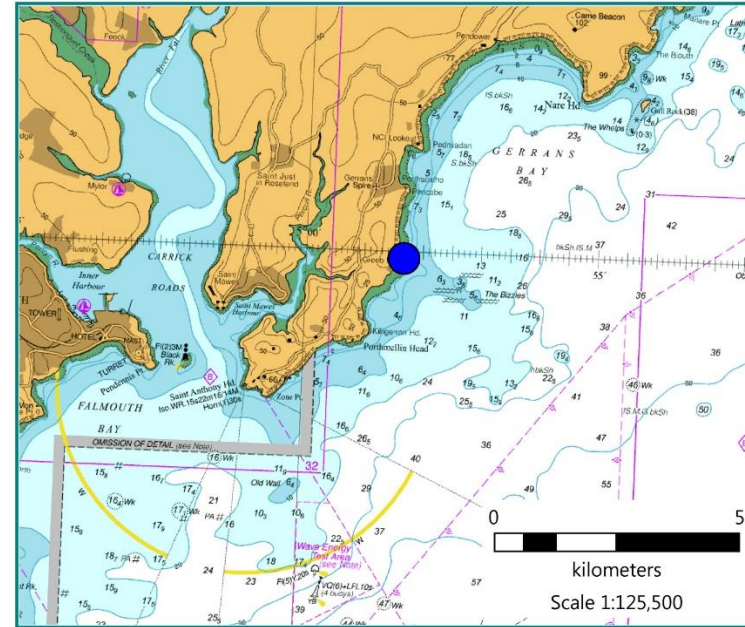
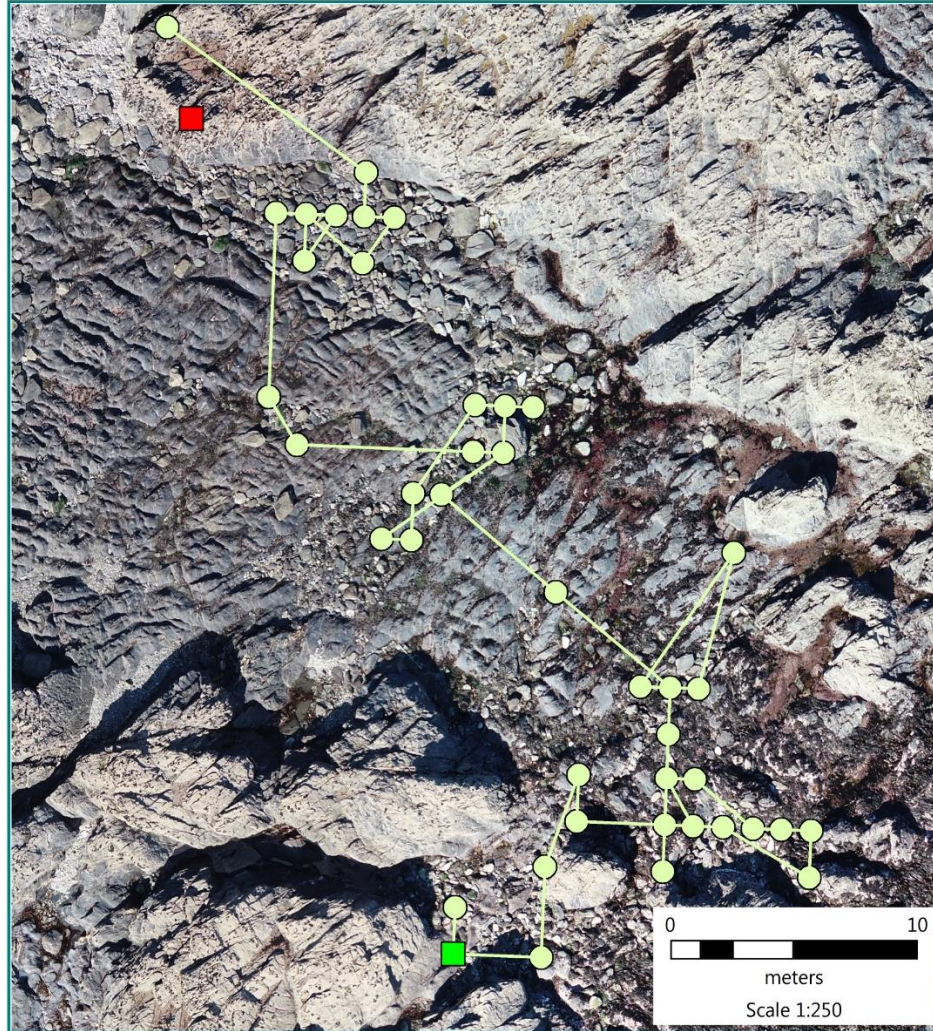
Figure 6: GPS track points from the intertidal survey on 3<sup>rd</sup> March 2022.





# GPS track positions from the Intertidal Edible Crab Survey 31st March 2022

Created by: C Daniels/ A Jenkin Date: 15/12/2022



### Legend

- Site location
- GPS track positions
- GPS track
- Start of Line
- End of Line

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Projection: Latitude/ Longitude WGS84

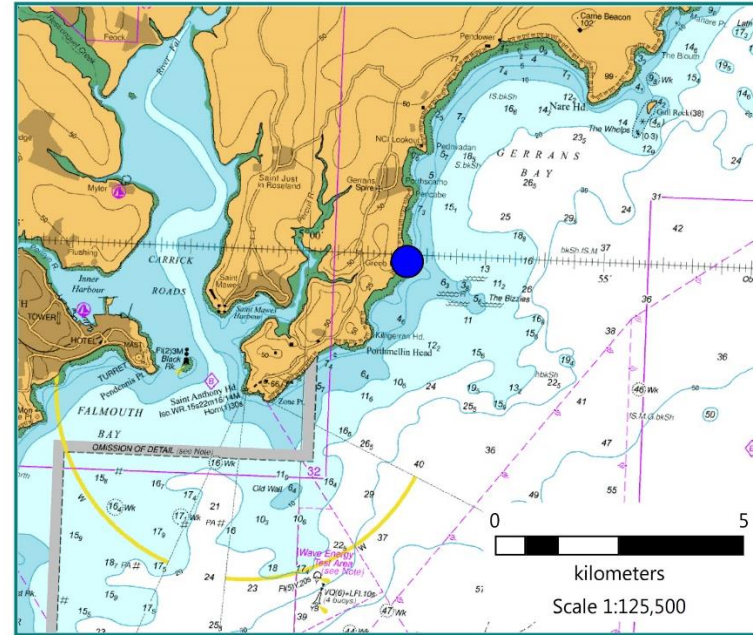
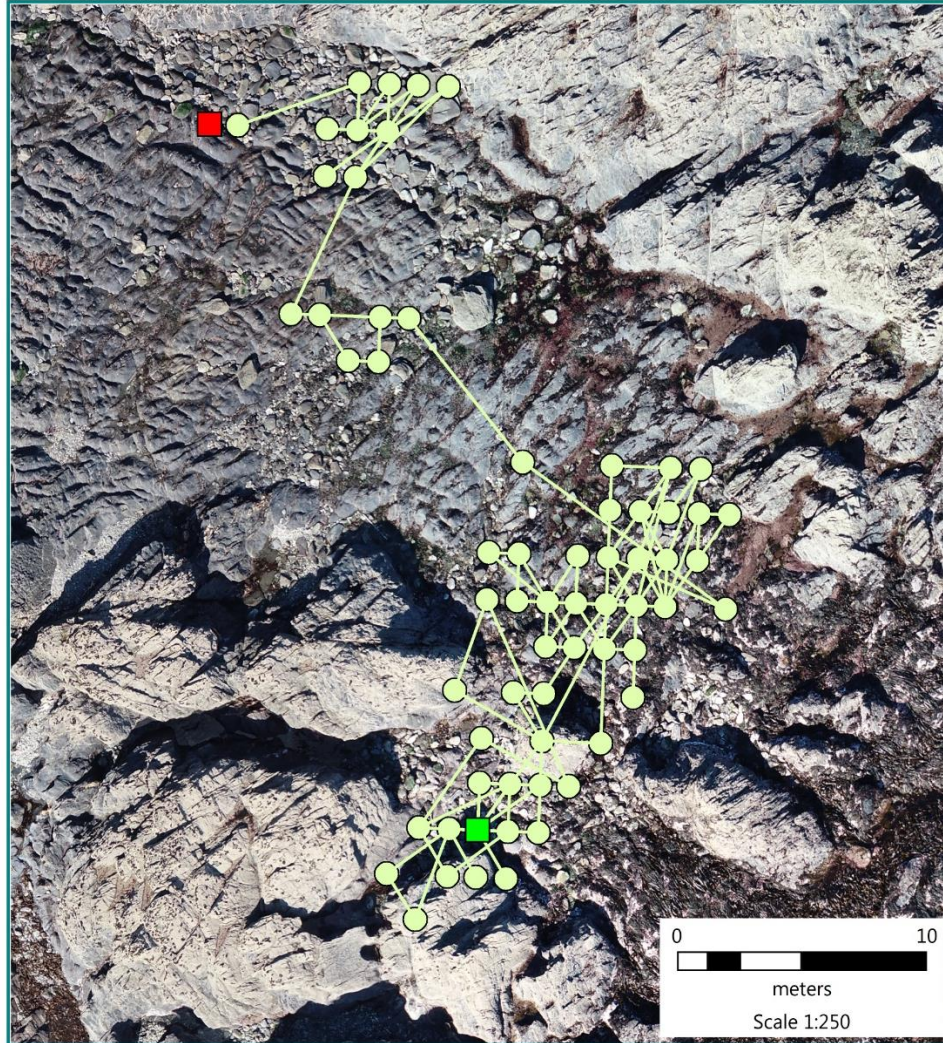
Figure 7: GPS track points from the intertidal survey on 31<sup>st</sup> March 2022.





# GPS track positions from the Intertidal Edible Crab Survey 15th June 2022

Created by: C Daniels/ A Jenkin Date: 15/12/2022



### Legend

- Site location
- GPS track positions
- GPS track
- Start of Line
- End of Line

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Projection: Latitude/ Longitude WGS84

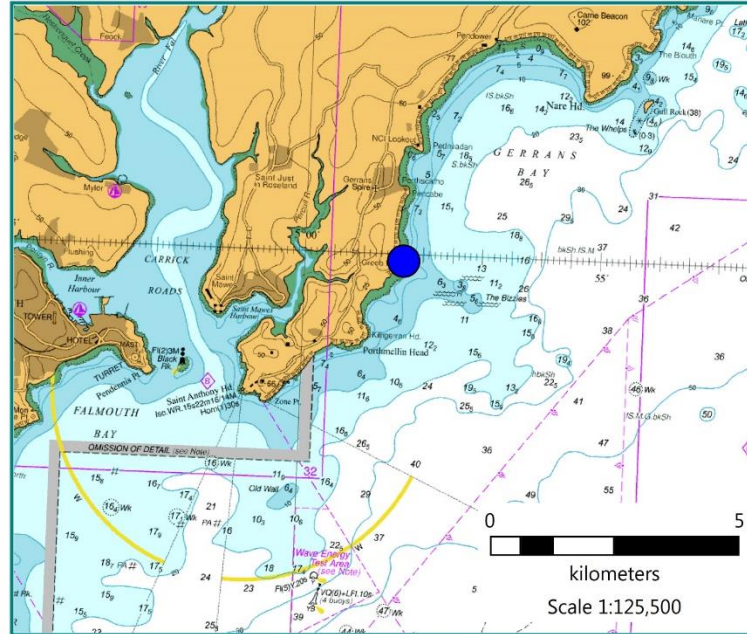
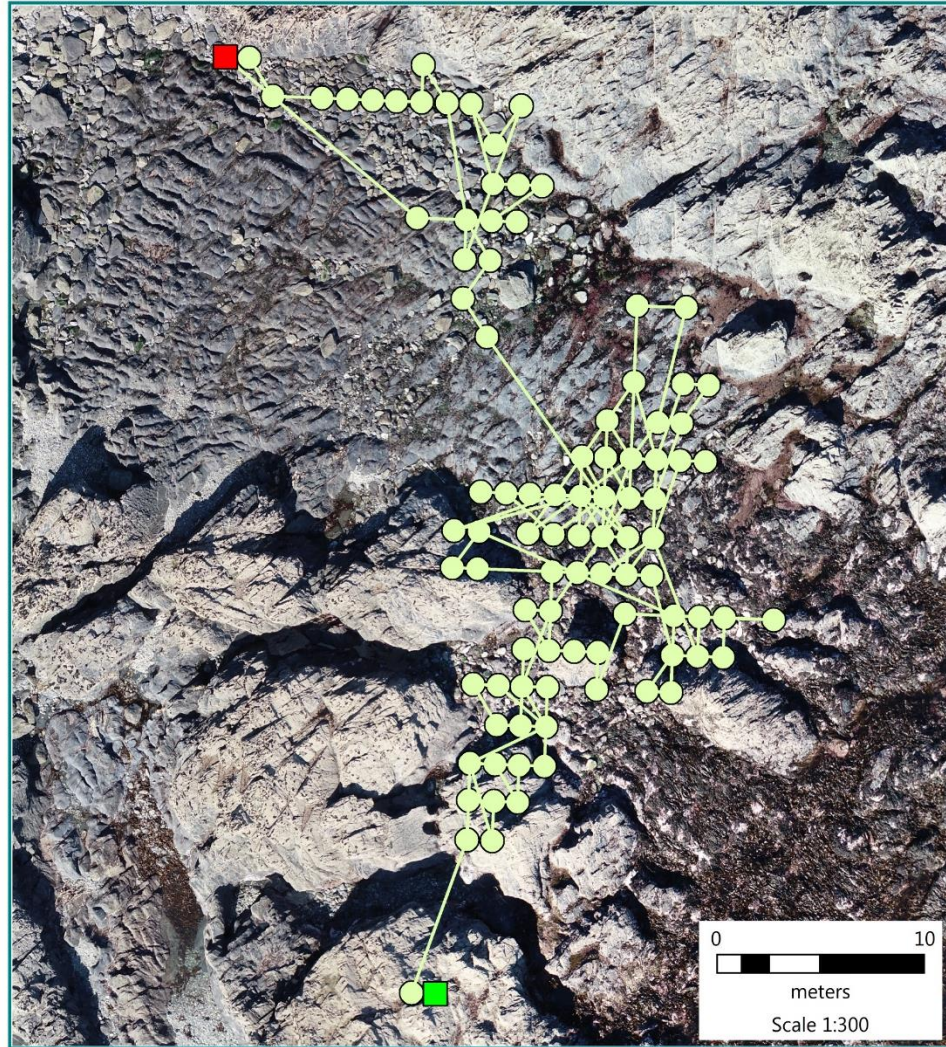
Figure 8: GPS track points from the intertidal survey on 15<sup>th</sup> June 2022.





# GPS track positions from the Intertidal Edible Crab Survey 14th July 2022

Created by: C Daniels/ A Jenkin Date: 15/12/2022



### Legend

- Site location
- GPS track positions
- GPS track
- Start of Line
- End of Line

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Projection: Latitude/ Longitude WGS84

Figure 9: GPS track points from the intertidal survey on 14<sup>th</sup> July 2022.



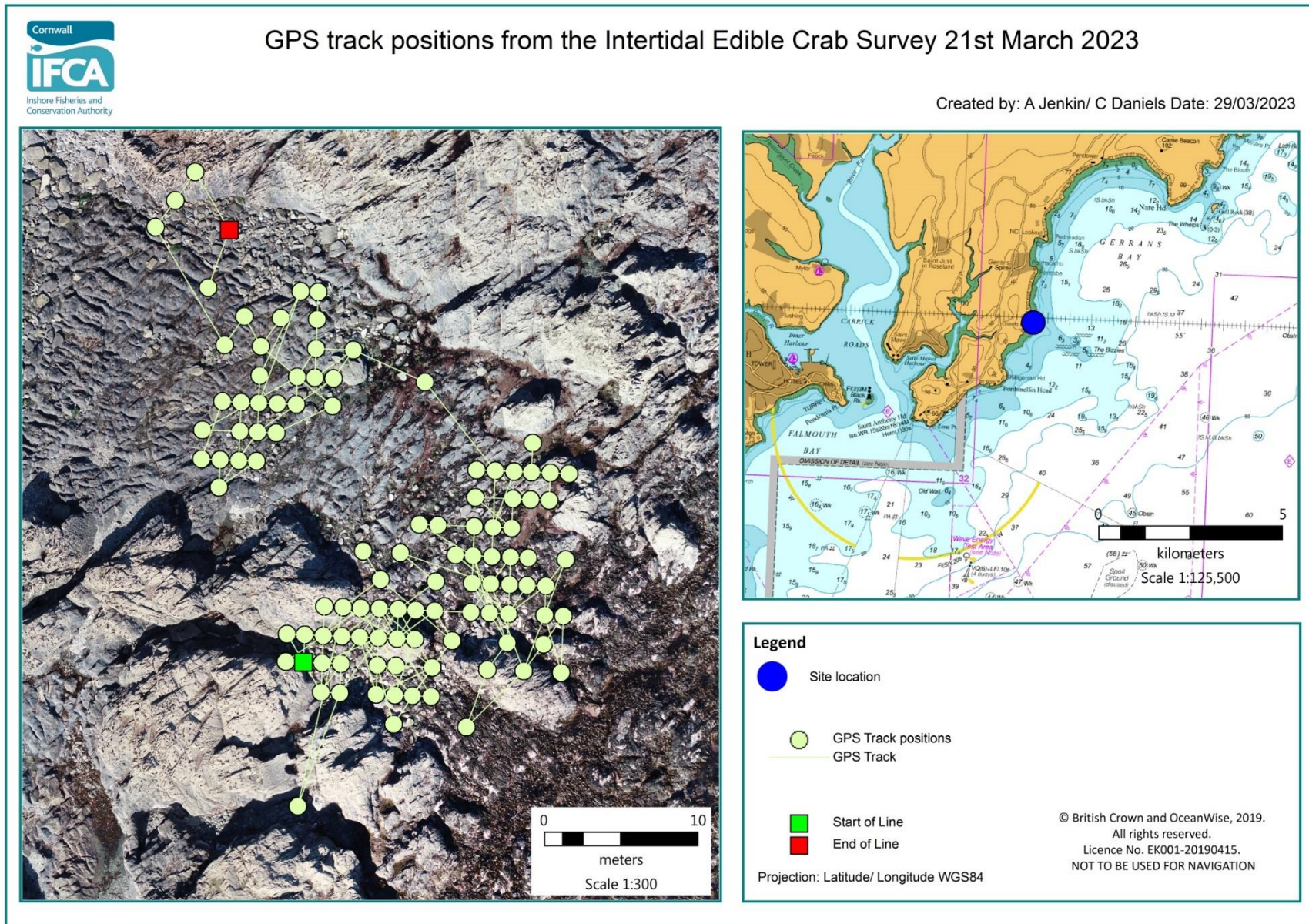


Figure 10: GPS track points from the intertidal survey on 21st March 2023.



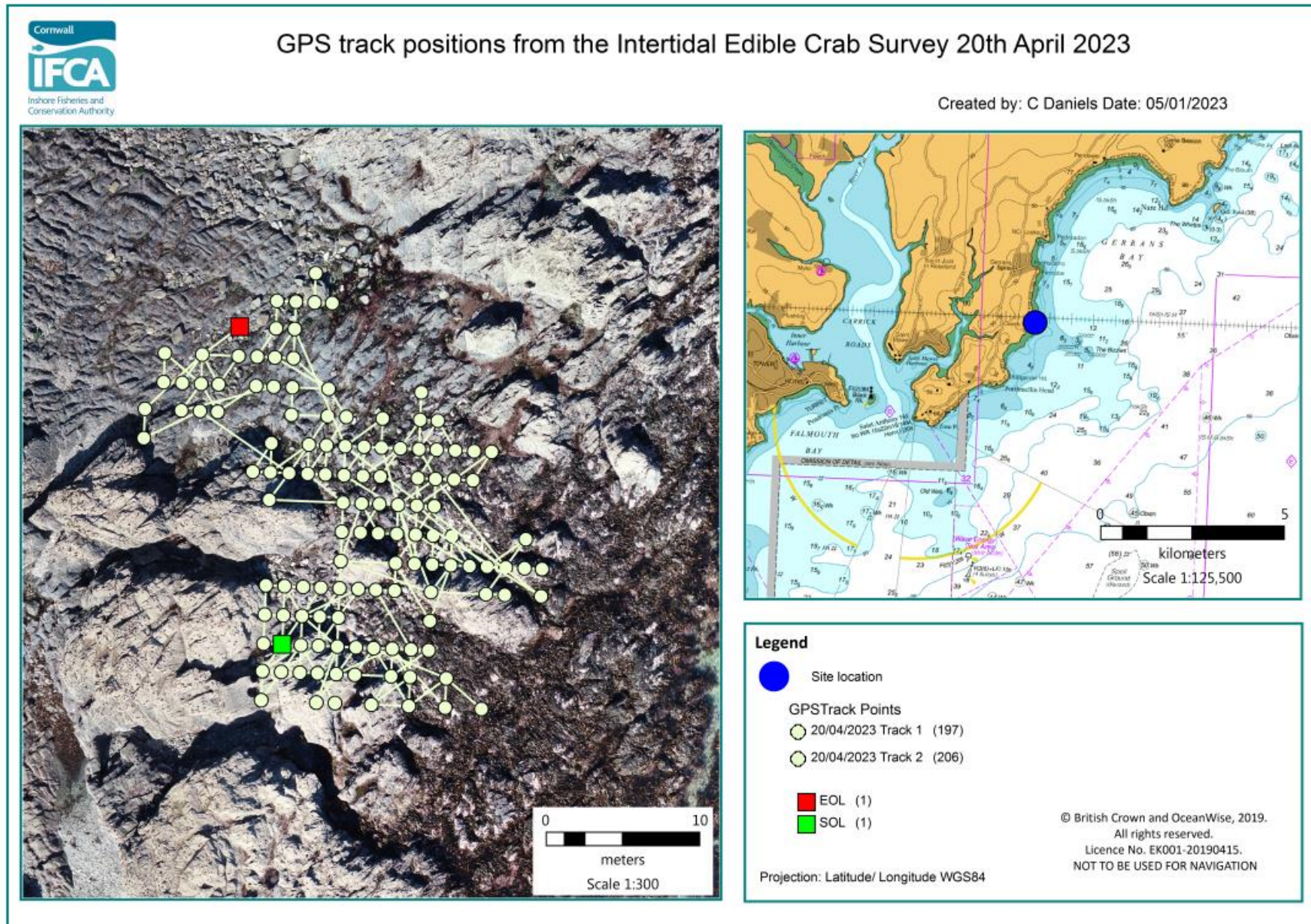


Figure 11: GPS track points from the intertidal survey on 20th April 2023.



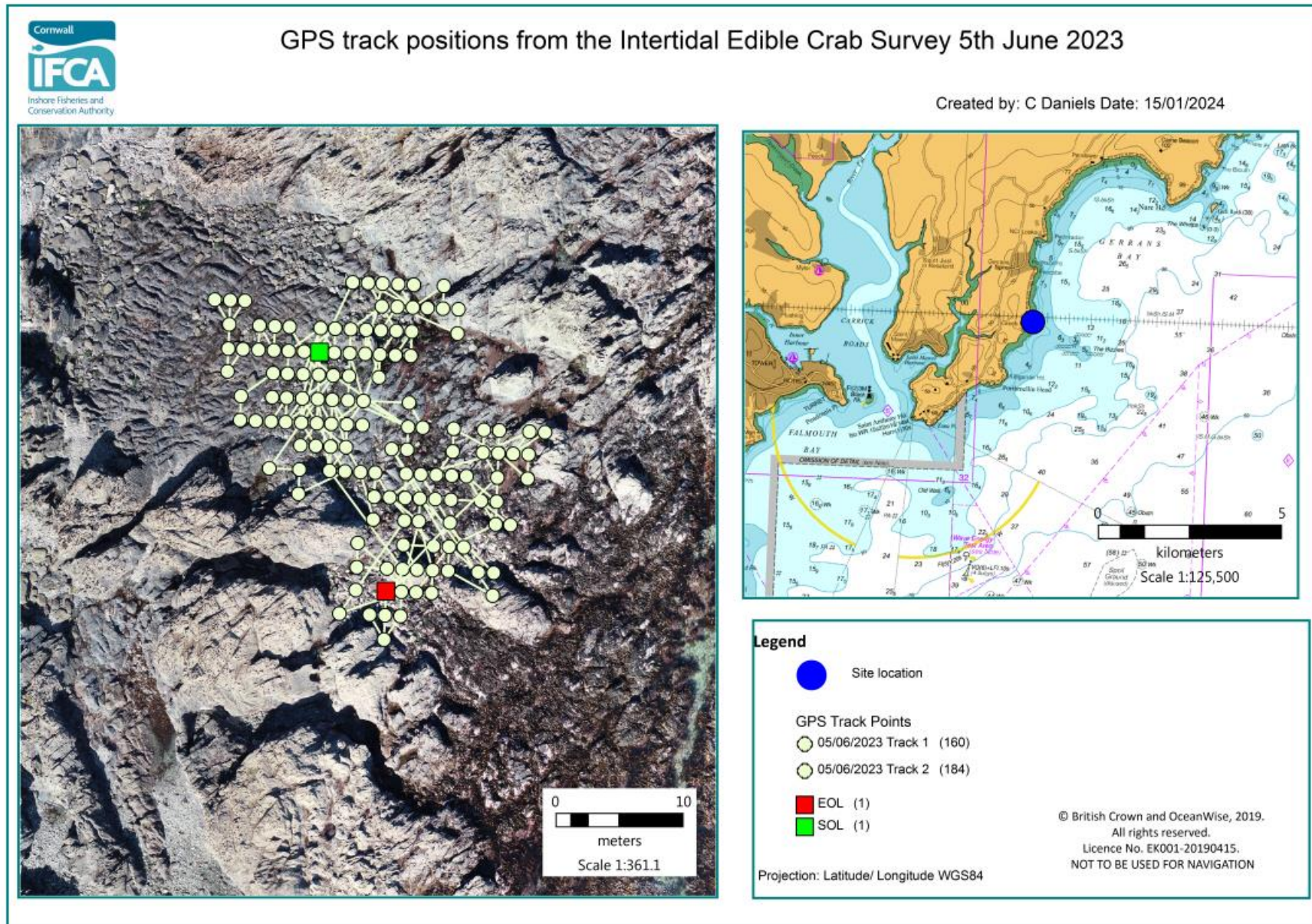


Figure 12: GPS track points from the intertidal survey on 5th June 2023.

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### 3.2 Edible Crabs (*Cancer pagurus*)

The total number, minimum size (mm), maximum size (mm) and average size (mm) of edible crabs, for each of the survey days, is shown in Table 4. The carapace size (mm), sex and any comments for individual crabs, for each survey day, are shown in Annex 2.

#### 3.2.1 Abundance

The abundance of edible crab across the survey period is displayed in Table 4. Edible crab abundance on any given survey day ranged from 18 to 65 crabs.

Table 4: The total number, minimum size (mm), maximum size (mm) and average size (mm) of edible crabs (*Cancer pagurus*) for each of the survey days between 2021 and 2023.

Date	Total number of crabs measured	Minimum size (mm)	Maximum size (mm)	Average size (mm)
29 <sup>th</sup> April 2021	65	12	92	32.51
27 <sup>th</sup> May 2021	37	16	77	37.35
23 <sup>rd</sup> June 2021	35	16	102	43.37
8 <sup>th</sup> October 2021	18	19	72	47.39
3 <sup>rd</sup> March 2022	44	12	156	39.67
31 <sup>st</sup> March 2022	56	11	94	37.23
15 <sup>th</sup> June 2022	41	21	86	50.68
14 <sup>th</sup> July 2022	29	24	97	57.66
21 <sup>st</sup> March 2023	37	12	91	42.38
20 <sup>th</sup> April 2023	46	10	88	43.17
5 <sup>th</sup> June 2023	34	11	93	51.47

When looking at edible crab abundance in more detail, there is an increase in the average number of edible crab encountered in 2022 surveys compared to 2021 and 2023 (Figure 13). Though the survey timings may have influenced this.

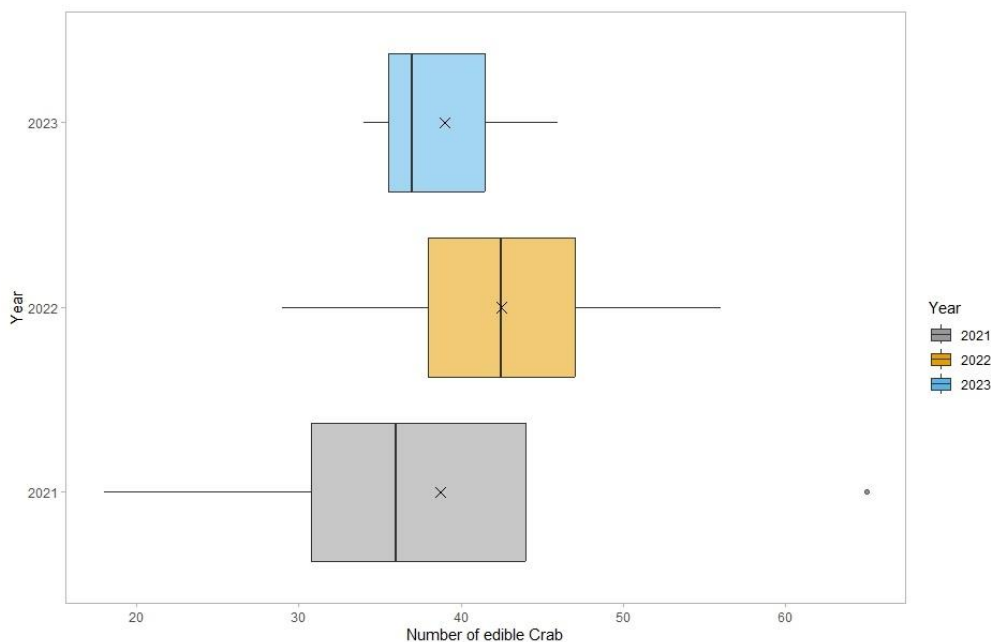


Figure 13: Edible crab (*Cancer pagurus*) survey abundance (number of crabs) over the 2021- 2023 intertidal surveys at Greeb point, grouped by year. The cross represents the mean, the solid line represents the median, boxes represent the interquartile range, whiskers represent 1.5 x interquartile range, and the filled circles represent outliers.

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There also appears to be a seasonal pattern present in abundance, with a decreasing number of edible crab recorded as the days of the year progress, within a given year (as shown by the negative correlations in

Figure 14). When comparing years there is a lot of overlap in the data, though the number of edible crab appears to get progressively lower, for given days of the year in later years, with 2023 showing the lowest linear regression line for the relationship between the number of crab and day of year (

Figure 14).

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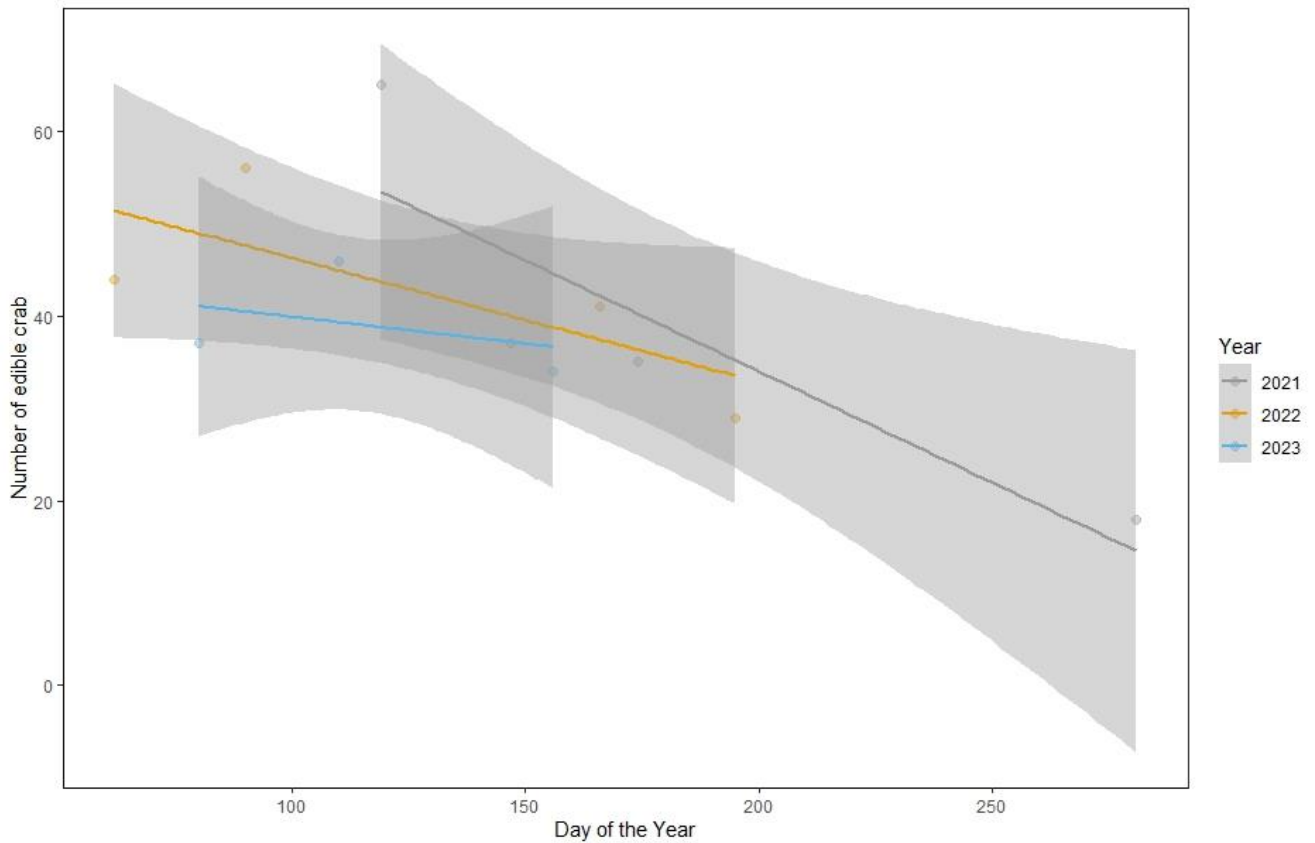


Figure 14: Edible crab (*Cancer pagurus*) abundance across the days of the year for the 2021- 2023 (2021 = grey, 2022 = Yellow, 2023 = Blue) during the intertidal surveys at Greeb Point. Yearly glm smoothing line (in corresponding colours) with 95% confidence intervals shown in grey.

### 3.2.2 Size Distribution

Average carapace width of edible crab for each survey day ranged from 32.51mm to 57.66mm (Table 4).

The distribution of edible crab sizes, across the survey period is displayed in the Carapace width frequency plots in Figure 15. Edible crab width throughout the surveys ranged from 10mm to 156mm.

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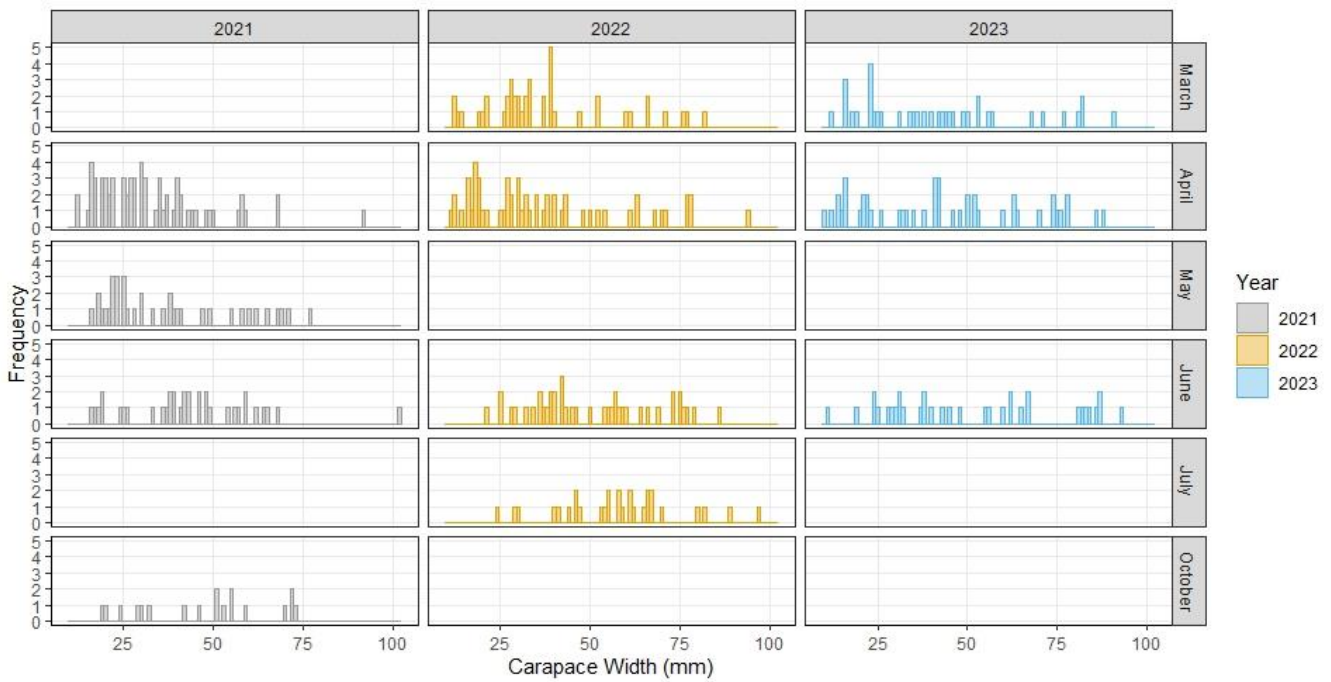


Figure 15: Edible crab (*Cancer pagurus*) carapace width/frequency distribution (for the 1mm size classes) separated by year and month of survey, with years shown in different colours (2021 grey, 2022 orange, 2023 blue)

When looking at edible crab size distribution in more detail, there is an increase in the average edible crab carapace width from 2021 to 2023, both when looking at the yearly average, and also the monthly average (when given months were repeated across more than 1 year – March/April/June) (Figure 16). There also appears to be a seasonal pattern present in carapace width, with larger edible crab present in the June, July and October surveys and smaller edible crab present in March, April and May (Figure 16).



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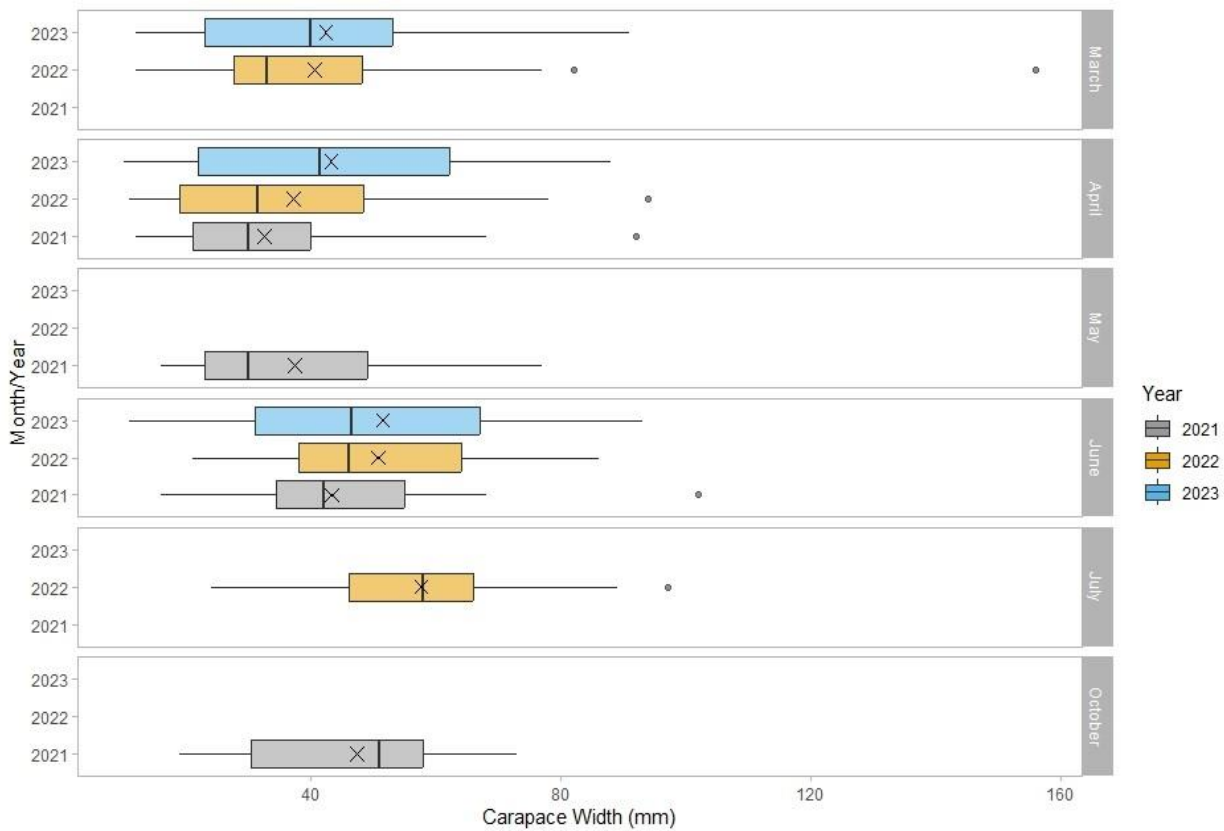
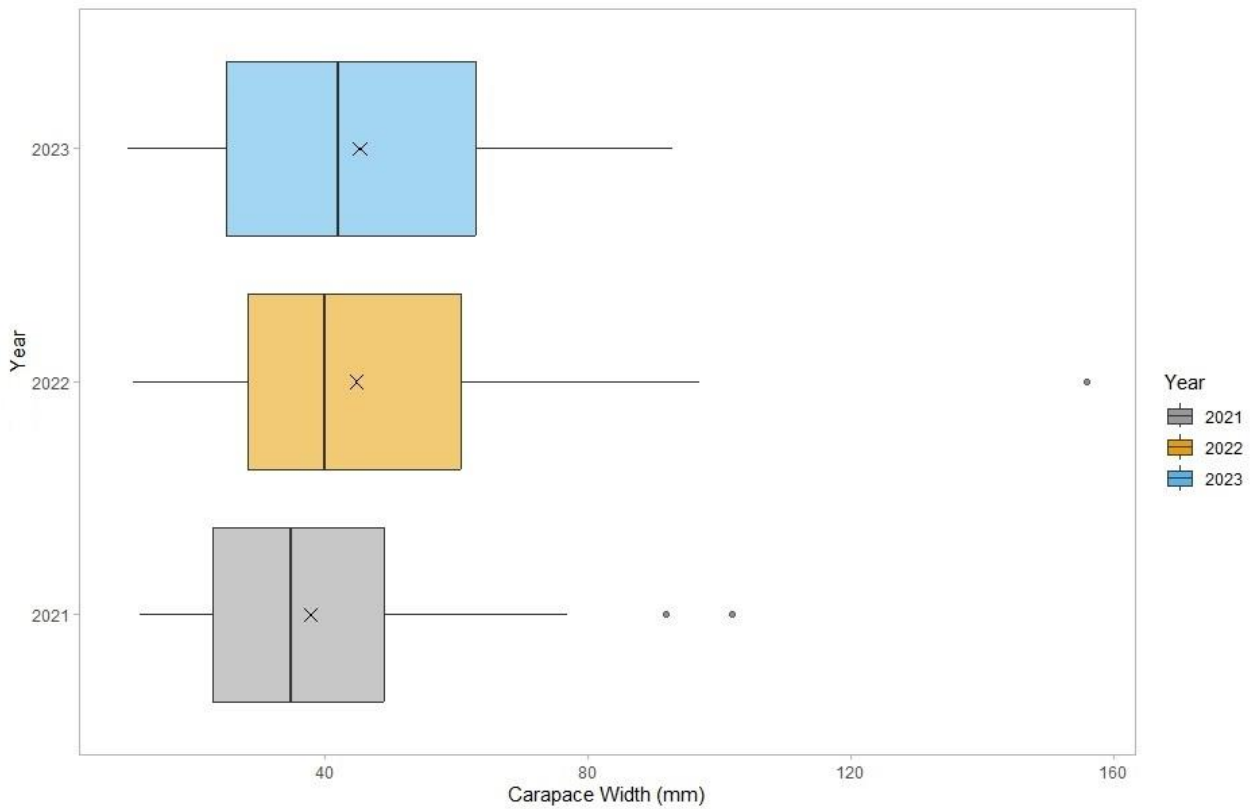


Figure 16: Edible crab (*Cancer pagurus*) carapace width (mm) over the 2021- 2023 intertidal surveys at Greeb point. Yearly summaries (top) and monthly summaries across the years (bottom) (2021 grey, 2022 orange, 2023 blue) The cross represents the mean, the solid line represents the median, boxes represent the interquartile range, whiskers represent 1.5 x interquartile range, and the filled circles represent outliers.



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This pattern of increasing carapace width as the year progresses is clearer when looking at carapace width against the day of the year (positive correlation for all years shown in Figure 17).

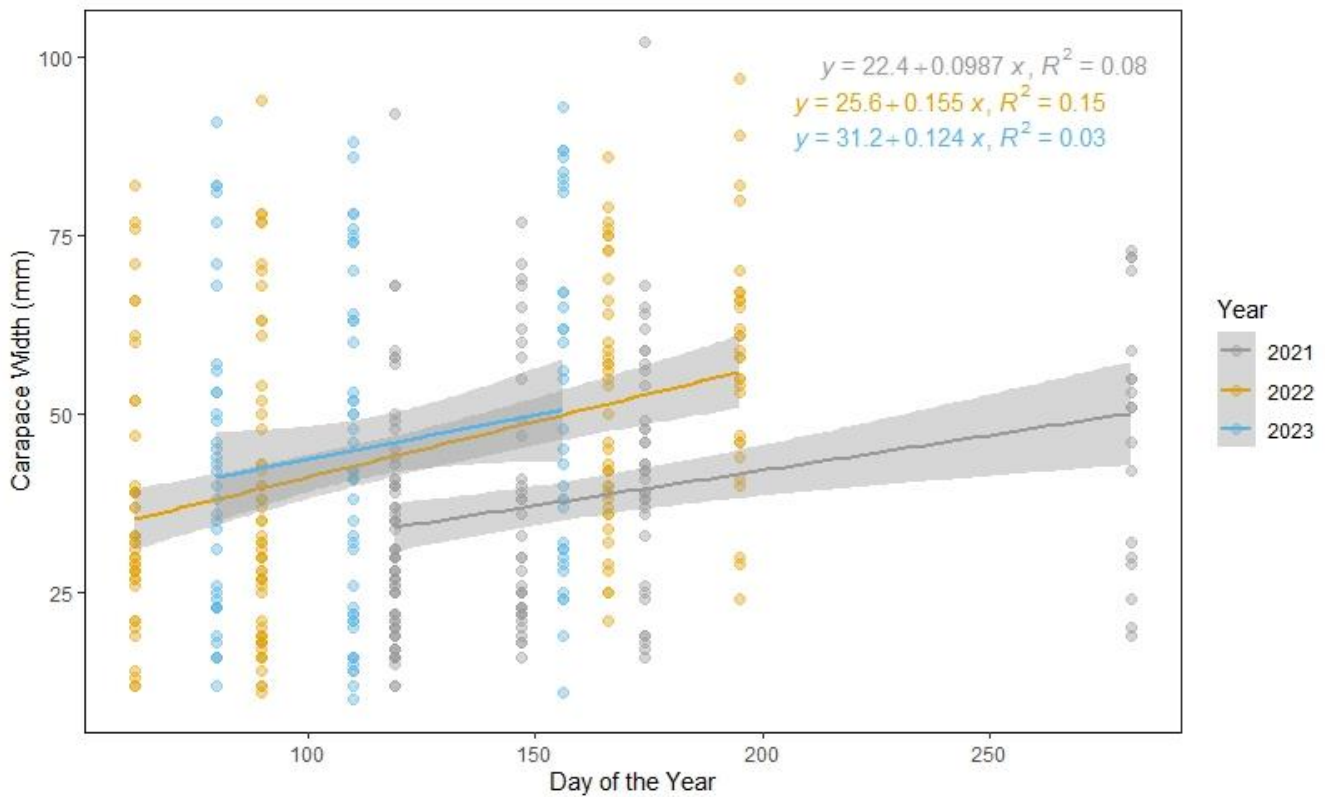


Figure 17: Edible crab (*Cancer pagurus*) carapace width (mm) across the days of the year for the 2021- 2023 (2021 = grey, 2022 = Yellow, 2023 = Blue) during the intertidal surveys at Greeb Point. Yearly linear regression lines plotted (in corresponding colours) with 95% confidence intervals in grey. Line equation and  $R^2$  represented.

### 3.2.3 Gender

It was not possible to assign gender to 356 of the 441 crabs across the surveys. Of those crabs that were  $\geq 60$ mm CL that it was possible to assign gender to (85 individuals), 62% were females and 38% were males (Table 5). Examples of cases where clear gender assignment was possible can be seen in Figure 18 (Top left [male] and top right [female]). Examples of crabs observed with carapace width  $< 60$ mm, across the years are shown in the bottom six pictures in Figure 18, with possible males on the left and females on the right.

## Carapace width greater than 60mm



2021



2022



2023



Figure 18: Images of the underside of edible crab (*Cancer pagurus*) as recorded during the intertidal edible crab surveys between 2021 and 2023. Top (row 1) pictures represent specimens >60mm Carapace width where clear male (left) and female (right) gender assignment was possible. Remaining pictures represent example from 2021 (row 2), 2022 (row 3) and 2023 (row 4) of crabs with carapace width <60mm, where gender differentiation was unclear.

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Table 5: Gender assignment of crabs throughout the surveys recorded in number of crabs (n) and % of gender assigned crabs (for Male and Female) and % of total crabs measured (for unsexed crabs).

Date	Total crabs measured	Male assignment		Female assignment		Unsexed	
		n	% of crabs gender assigned	n	% of crabs gender assigned	n	% of crabs measured
29 <sup>th</sup> April 2021	65	1	33	2	67	62	95
27 <sup>th</sup> May 2021	37	4	67	2	33	31	84
23 <sup>rd</sup> June 2021	35	2	40	3	60	30	86
8 <sup>th</sup> October 2021	18	2	50	2	50	14	78
3 <sup>rd</sup> March 2022	43	3	38	4	50	36	82
31 <sup>st</sup> March 2022	56	3	27	8	73	45	80
15 <sup>th</sup> June 2022	41	5	42	7	58	29	71
14 <sup>th</sup> July 2022	29	5	39	8	62	16	55
21 <sup>st</sup> March 2023	37	1	14	6	86	30	81
20 <sup>th</sup> April 2023	46	4	33	8	67	34	74
5 <sup>th</sup> June 2023	34	2	40	3	60	29	85
<b>Totals</b>	<b>441</b>	<b>32</b>	<b>38</b>	<b>53</b>	<b>62</b>	<b>356</b>	<b>81</b>

### 3.2.4 Growth Increment

A total of eight soft shelled crabs were recorded next to exuviae (moult) over the survey period, which allowed record and calculation of the growth increment (Table 6). The average growth increment across the study period and individuals measured was 28.8% increase in size at moult (with a minimum of 22.5% increase in size at moult and a maximum = 38.5% increase in size ay moult). Examples of soft-shelled crabs and their respective moult are shown in Figure 19.

Table 6: Edible crab (*Cancer pagurus*) growth increment data collected from 2021-2023 surveys.

Date measured	Premoult width (mm)	Postmoult width (mm)	Increment (mm)	Increment (% increase)
29 <sup>th</sup> April 2021	71	92	21	29.6
27 <sup>th</sup> May 2021	45	55	10	22.2
27 <sup>th</sup> May 2021	17	22	5	29.4
8 <sup>th</sup> October 2021	56	70	14	25.0
8 <sup>th</sup> October 2021	24	30	6	25.0
14 <sup>th</sup> July 2022	35	46	11	31.4
14 <sup>th</sup> July 2022	69	89	20	29.0
21 <sup>st</sup> March 2023	13	18	5	38.5





Figure 19: Soft shelled edible crab (*Cancer pagurus*) and its moult found next to each other from 29th April 2021, 8th October 2021, 14<sup>th</sup> July 2022 and 21<sup>st</sup> March 2023 respectively.

### 3.3 Non-native species

Scientific officers were focused on finding and recording edible crabs therefore the observing and recording on non-native species was a minor part of the survey. However, a large amount of Japanese wireweed (*Sargassum muticum*) was noted covering the pools throughout the surveys, particularly when the air temperature was warmer.

## 4 Discussion

The surveys were successful in sampling pre-recruit edible crabs.

Pre-recruit (<150mm carapace width female and <160mm carapace width male) edible crabs were found in abundance at this survey site during all surveys. The crabs were mostly found buried in coarse sand under pebbles, cobbles and boulders, often located within gullies. This habitat is shown in Figure 20. There were more edible crabs apparent at the beginning of the year, in comparison to later in the year, shown by the downwards trend in abundance as the day of the year increased. This was seen across all survey years, suggesting that crabs start to move from the habitat later in the year.



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Figure 20: The habitat surveyed during the Cornwall IFCA intertidal edible crab survey.

Seasonally variation in the crab size was also apparent across all years, with smaller edible crabs present early in the year (in March, April and May) and larger edible crabs present later in the year (in the June, July and October surveys). This pattern was shown across years with a positive correlation between carapace width and the day of the year, suggesting that crabs grow on the habitat during the summer months.

The number of crabs recorded decreased as the day of the year progressed. In June and July, the tidal pools were full of algae which made surveys more difficult (Figure 21). This may explain why the current survey does not appear to capture settlement of juvenile crabs into the intertidal habitat which we would expect to see between June and October (Robinson and Tully, 2000). The water in the pools and gullies was also noticeably warmer in June and July. The influence of the warmer conditions was not investigated further but perhaps the crabs buried deeper to find cooler conditions or moved to deeper intertidal positions on the shore, which was observed during the surveys with a greater number of larger crabs recorded further down the shore.



Figure 21. Example of June and July observations where the tidal pools were full of algae.

Recently moulted crabs provided an indicator of growth of the crabs along this stretch of coastline, with an average increase in size at moult of  $\sim 30\%$ , similar to that found during an edible crab tagging study in the South

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West of England (Bennett, 1974). The freshly moulted crabs felt very soft and were likely to be recently moulted but it is unknown if they had completed taking on water before hardening, therefore their post moult size may be an underestimation if this process was not complete.

The data of these surveys was not directly compared to the findings of Smith (2012a and 2012b) conducted at the same site, as the exact route surveyed is not known for that study and the methodology varied slightly to allow the current survey to record extra data on the crabs. Due to the scoping nature of this work, the data presented in this report has also been compared with caution between the years due to the variability in survey timings, positioning and the number of officers sampling during the sample events. However, clearly similarities were observed between years with a greater number of larger crabs recorded later in the year and a decrease in crab numbers through the year.

When looking at the ratios of males to females in the intertidal population, the results of this survey relate closely to the that found during crustacean catch sampling onboard fishing vessels in the CIFCA district between 2003 and 2006, which showed males to represent 39% (compared to 38% in the current study) of the population and females to represent 61% (compared to 62% in the current study) of the population (Davis, 2007).

The current three-year survey has shown that this type of sampling could be suitable as a proxy for long term trends in abundance on a local scale (in a given survey area). The 2021 survey methodology was refined in 2022 and 2023, with the resulting method (used in 2023) providing a repeatable survey for future years. The current three-year survey provides a baseline against which future surveys can be compared. However, to scale it up to monitor intertidal crab abundance across the Cornwall IFCA district would take a considerable amount of time and effort and would depend on time and resource constraints.

Once further year's data are collected using the standardised 2023 methodology, it would be interesting to compare local LPUE in the fishery (examples of data available can be found in Street et al., 2022) to look for any trend between the datasets. For example, links between LPUE and intertidal crab abundance at ~2/3 years apart (the approximate time they spend in the intertidal before moving to deeper water [Thrupp et al., 2015]). Such correlations may allow the use of these intertidal surveys as a proxy for determining potential recruitment into the fishery for the species in the Cornwall IFCA district when linked with growth increment data for the species.

## 5 Limitations

- An abundance of algae during periods of hot weather could have limited officers being able to find crabs, as the pools were covered by the algae.
- A low number of edible crabs were seen in nooks and crevices but could not be measured as there was no easy way to extract them without damaging them.

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- The size of the freshly moulted crab could be misrepresentative. Crabs take up water from the environment after moulting before the exoskeleton hardens at a larger size and it is unknown at what stage in this process the crabs were sampled.
- As 2021 and 2022 were exploratory years to determine the best practice in field data collection (which was applied in 2023), annual comparisons in this report are made with a degree of caution.
- The surveys undertaken do not provide enough continuous data collected using standardised protocols to make comparisons with permit returns (landings) data from the vicinity. Further surveys are required to enable making such comparisons and in turn to understand potential for surveys to help understand recruitment in the district.

## 6 Recommendations

- Cornwall IFCA officers agree that repeating surveys in the same months as 2023 (March/April/June), would be the best practice for a longer-term study, to ensure comparisons can be made across years with confidence. But survey planning should consider resource and time constraints from the outset to ensure yearly surveys are repeatable and therefore comparable.
- Extension of the survey to include further suitable intertidal edible crab survey sites of different geographical location within the Cornwall IFCA district (north or west coast) would be beneficial, depending on resource and time constraints. If resources are restrictive then possibly conducting one survey annually at each site, in the month that gave constantly high abundance records (April), would be worth considering.
- Use of sea surface temperature records for the area could be used to model against crab abundance/size once a dataset using standardised protocols is available.
- Taking photos, though more time consuming, provides a reference point for gender assignment and clarity for future comparisons.
- Alternatively, or in addition to intertidal surveys, pre-recruit assessments could be conducted through current crustacean catch survey work across the district (smallest edible crab recorded in recent pot surveys = 60mm carapace width).
- Use longer term datasets gathered using the Intertidal crab surveys to start understanding the relationships between landings and Juvenile abundance on Intertidal crab grounds with the intention of helping to predict recruitment into the edible crab fishery in the district.
- Records of water temperature from the surveys and or sea surface temperature records should be used in future to compare young of year settlement against to look for correlations.
- It would be worth separating out abundance data across different year classes of edible crabs found on intertidal surveys to help predict future trends in recruitment to the fishery for different years.
- Cornwall IFCA officers have observed an increasing occurrence of two species of crab that inhabit similar intertidal ranges as the edible crabs and are known to be increasing in abundance in the UK (Inaturalist, 2024 a,b), the furrowed crab (*Xantho hydrophilus*) and the Risso's Crab (*Xantho pilipes*). As such, future

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surveys may want to consider recording the abundance of these species alongside *C. pagurus* to determine potential correlations between species abundance.



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## 8 Appendices

## Annex 1 – Daily logs

## Daily log 1


Annex Table A: Daily log for 29th April 2021.

<b>Project</b>	Intertidal Survey for edible crabs			<b>Survey code</b>	20210429_CIFCA_INT_GRE		
<b>Date</b>	2021-04-29	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>			
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	NNW		
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	10 mph		
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	4		
<b>IFCA officers</b>	Annie Jenkin, Stephanie Sturgeon			<b>Cloud coverage</b>	8/8		
<b>Others</b>	None			<b>Time recorded</b>	11:50		
<b>Low water time</b>	14:15:00 (BST)	<b>Time start</b>	11:55:00 (UTC)	<b>Wind direction</b>		<i>Data entered by</i>	
<b>Low water (m)</b>	0.14 m	<b>Time end</b>	14:13:00 (UTC)	<b>Wind speed</b>		SS (2021-04-30)	
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	11:45	<b>Beaufort scale</b>			
				<b>Cloud coverage</b>			
				<b>Time recorded</b>			
<b>Description of survey</b>	Trial intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 65 brown crabs were recorded as part of the survey						
<b>Time</b>	<b>Type</b>	<b>Details/description</b>					
11:15		Arrive Greeb Point					
11:55	INT	Location 1 Start					
14:13	INT	Location 1 End					
14:45		Depart Greeb Point					

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## Daily log 2


Annex Table B: Daily log for 27th May 2021.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20210527_CIFCA_INT_GRE			
<b>Date</b>	2021-05-27	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>			
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	SSE		
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	10-14 mph		
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	2		
<b>IFCA officers</b>	Stephanie Sturgeon			<b>Cloud coverage</b>	5/8		
<b>Others</b>	None			<b>Time recorded</b>	11:45		
<b>Low water time</b>	13:15:00 (BST)	<b>Time start</b>	11:48:00 (UTC)	<b>Wind direction</b>			<i>Data entered by</i>
<b>Low water (m)</b>	0.25 m	<b>Time end</b>	13:31:00 UTC)	<b>Wind speed</b>			SS (2021-05-28)
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>		<b>Beaufort scale</b>			
				<b>Cloud coverage</b>			
				<b>Time recorded</b>			
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 37 brown crabs were recorded as part of the survey. A noticeable increase in velvet swimming crabs and Montagu's crab was observed compared to the previous survey.						
<b>Notes</b>	Three strings of gear near survey site. Pair of white and orange flags just off long gully. Blue bottle to white bottle further off. Pair of orange bouys north of access point. Pair of orange bouys near Towan Beach.						
<b>Time</b>	<b>Type</b>	<b>Details/description</b>					
11:45		Arrive Greeb Point					
11:48	INT	Location 1 Start					
13:31	INT	Location 1 End					
13:45		Depart Greeb Point					

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## Daily log 3


Annex Table C: Daily log for 23rd June 2021.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20210623_CIFCA_INT_GRE		
<b>Date</b>	2021-06-23	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>		
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	NE	
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	6-10 mph	
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	3	
<b>IFCA officers</b>	Stephanie Sturgeon and Annie Jenkin			<b>Cloud coverage</b>	1/8	
<b>Others</b>	None			<b>Air temperature</b>	17 °C	
				<b>Time recorded</b>	09:35	
<b>Low water time</b>	11:11:00 (BST)	<b>Time start</b>	09:37:00 (UTC)	<b>Wind direction</b>		<i>Data entered by</i>
<b>Low water (m)</b>	0.72 m	<b>Time end</b>	11:23:00 (UTC)	<b>Wind speed</b>		SS (2021-06-25)
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	09:30	<b>Beaufort scale</b>		
				<b>Cloud coverage</b>		
				<b>Time recorded</b>		
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portsatho on the S coast of Cornwall. 35 brown crabs were recorded as part of the survey.					
<b>Notes</b>	A noticeable increase in algae coverage over rocks, Montagu's crabs more abundant and larger velvet swimming crabs.					
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
09:25		Arrive Greeb Point				
09:37	INT	Location 1 Start				
11:23	INT	Location 1 End				
11:55		Depart Greeb Point				

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## Daily log 4

Annex Table D: Daily log for 8th October 2021.


<b>Project</b>	Intertidal Survey for edible crabs			<b>Survey code</b>	20211008_CIFCA_INT_GRE		
<b>Date</b>	2021-10-08	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>			
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	SE		
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	10-13 mph		
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	3		
<b>IFCA officers</b>	Stephanie Sturgeon and Annie Jenkin			<b>Cloud coverage</b>	1/8		
<b>Others</b>	None			<b>Air temperature</b>	17 °C		
				<b>Time recorded</b>	12:10		
<b>Low water time</b>	13:49 (BST)	<b>Time start</b>	12:17:00 (UTC)	<b>Wind direction</b>		<i>Data entered by</i>	
<b>Low water (m)</b>	0.29	<b>Time end</b>	14:27:00 (UTC)	<b>Wind speed</b>		AJ (2021-10-11)	
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	12:10	<b>Beaufort scale</b>			
				<b>Cloud coverage</b>			
				<b>Time recorded</b>			
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 18 brown crabs were recorded as part of the survey, 2 were seen stuck in crevices and 1 sunk in to the sediment before it could be measured						
<b>Notes</b>	A noticeable increase in brown algae coverage over rocks and less green algae						
<b>Time</b>	<b>Type</b>	<b>Details/description</b>					
11:55		Arrive Greeb Point					
12:17	INT	Location 1 Start					
14:27	INT	Location 1 End					
14:40		Depart Greeb Point					



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## Daily log 5


Annex Table E: Daily log for 3<sup>rd</sup> March 2022.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20220303_CIFCA_INT_GRE		
<b>Date</b>	2022-03-03	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>		
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	NW	
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	17-25 mph	
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	2	
<b>IFCA officers</b>	Stephanie Sturgeon and Annie Jenkin			<b>Cloud coverage</b>	6/8	
<b>Others</b>	None			<b>Air temperature</b>	9 °C	
				<b>Time recorded</b>	14:00	
<b>Low water time</b>	12:30 (UTC)	<b>Time start</b>	12:01:00 (UTC)	<b>Wind direction</b>		<i>Data entered by</i>
<b>Low water (m)</b>	0.10	<b>Time end</b>	13:44:00 (UTC)	<b>Wind speed</b>		SS (2022-03-04)
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	11:59	<b>Beaufort scale</b>		
				<b>Cloud coverage</b>		
				<b>Time recorded</b>		
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 43 live brown crabs were recorded as part of the survey					
<b>Notes</b>						
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
11:55		Arrive Greeb Point				
12:01	INT	Location 1 Start				
13:44	INT	Location 1 End				
14:10		Depart Greeb Point				

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## Daily log 6


Annex Table F: Daily log for 31<sup>st</sup> March 2022.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20220331_CIFCA_INT_GRE		
<b>Date</b>	2022-03-31	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>		
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	ENE	
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	20-35 mph	
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	3	
<b>IFCA officers</b>	Stephanie Sturgeon and Annie Jenkin			<b>Cloud coverage</b>	3/8	
<b>Others</b>	None			<b>Air temperature</b>	7 °C	
				<b>Time recorded</b>	12:50 (UTC)	
<b>Low water time</b>	12:26 (BST)	<b>Time start</b>	11:14:16 (UTC)	<b>Wind direction</b>		
<b>Low water (m)</b>	0.56	<b>Time end</b>	12:43:57 (UTC)	<b>Wind speed</b>		
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	N/A	<b>Beaufort scale</b>		
				<b>Cloud coverage</b>		
				<b>Time recorded</b>		
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 56 live brown crabs were recorded as part of the survey					<i>Data entered by</i>
<b>Notes</b>	Cold, strong NE wind blowing across the survey site making it hard to see in some of the rockpools					SS (2022-04-01)
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
11:00		Arrive Greeb Point				
11:14	INT	Location 1 Start				
12:43	INT	Location 1 End				
13:15		Depart Greeb Point				

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## Daily log 7

Annex Table G: Daily log for 15<sup>th</sup> June 2022.


<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20220615_CIFCA_INT_GRE		
<b>Date</b>	2022-06-15	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>		
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	NW	
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	10 mph	
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	2	
<b>IFCA officers</b>	Stephanie Sturgeon and Annie Jenkin			<b>Cloud coverage</b>	3/8	
<b>Others</b>	None			<b>Air temperature</b>	19 °C	
				<b>Time recorded</b>	11:40 (UTC)	
<b>Low water time</b>	13:11 (BST)	<b>Time start</b>	11:43:50 (UTC)	<b>Wind direction</b>		<i>Data entered by</i>
<b>Low water (m)</b>	0.49	<b>Time end</b>	13:22:11 (UTC)	<b>Wind speed</b>		SS (2022-06-16)
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	N/A	<b>Beaufort scale</b>		
				<b>Cloud coverage</b>		
				<b>Time recorded</b>		
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 41 live brown crabs were recorded as part of the survey					
<b>Notes</b>	Lots more green algae cover					
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
11:30		Arrive Greeb Point				
11:43	INT	Location 1 Start				
13:22	INT	Location 1 End				
13:35		Depart Greeb Point				



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## Daily log 8


Annex Table H: Daily log for 14<sup>th</sup> July 2022.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20220714_CIFCA_INT_GRE		
<b>Date</b>	2022-07-14	<b>Coordinate reference system</b>	WGS84	<b>Weather</b>		
<b>Location</b>	Greeb Point	<b>Position Fix</b>	Handheld GPS	<b>Wind direction</b>	N	
<b>Survey Type</b>	INT	<b>Horizontal Accuracy</b>	Approx 6m	<b>Wind speed</b>	20 mph	
		<b>Time zone</b>	UTC	<b>Beaufort scale</b>	2	
<b>IFCA officers</b>	Stephanie Sturgeon and Annie Jenkin			<b>Cloud coverage</b>	1/8	
<b>Others</b>	None			<b>Air temperature</b>	22 °C	
				<b>Time recorded</b>	11:40 (UTC)	
<b>Low water time</b>	13:04 (BST)	<b>Time start</b>	11:03 (UTC)	<b>Wind direction</b>		
<b>Low water (m)</b>	0.58	<b>Time end</b>	12:47 (UTC)	<b>Wind speed</b>		
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	N/A	<b>Beaufort scale</b>		
				<b>Cloud coverage</b>		
				<b>Time recorded</b>		
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 29 live brown crabs were recorded as part of the survey					<i>Data entered by</i>
<b>Notes</b>	Lots more green algae cover					SS (2022-07-18)
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
10:50		Arrive Greeb Point				
11:03	INT	Location 1 Start				
12:47	INT	Location 1 End				
13:25		Depart Greeb Point				

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## Daily log 9


Annex Table I: Daily log for 21st March 2023.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20230321_CIFCA_INT_GRE		
<b>Date</b>	21/03/2023	<b>GPS &amp; Time:</b>		<b>Weather Recorded</b>	11:40 (UTC)	
<b>Location</b>	Greeb Point	<b>Coordinate reference system</b>	WGS84	<b>Wind direction</b>	SW	
<b>Survey Type</b>	INT	<b>Position Fix</b>	Handheld GPS	<b>Wind speed</b>	17-23 mph	
<b>IFCA officers</b>	AJ, SS & CD	<b>Horizontal Accuracy</b>	Approx 6m	<b>Beaufort scale</b>	3	<i>Data entered by:</i>
<b>Others</b>	None	<b>Time zone</b>	UTC	<b>Cloud coverage</b>	7/8	
<b>Low water time</b>	11:40 (UTC)	<b>Time start</b>	10:54	<b>Pressure</b>	1009 mb	SS (2023-03-22)
<b>Low water (m)</b>	0.10	<b>Time end</b>	12:47	<b>Air temperature</b>	11 °C	<i>QA by:</i>
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	N/A	<b>Water temperature</b>	11.9 °C	AJ (2023-03-22)
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 35 live brown crabs were recorded as part of the survey					
<b>Notes</b>	Two dead edible crabs found and four empty carapaces					
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
10:40		Arrive Greeb Point				
10:54	INT	Location 1 Start				
12:47	INT	Location 1 End				
13:10		Depart Greeb Point				

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## Daily log 10

Annex Table J: Daily log for 20th April 2023.


<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20230420_CIFCA_INT_GRE		
<b>Date</b>	20/04/2023	<b>GPS &amp; Time:</b>		<b>Weather Recorded</b>	11:00 (UTC)	
<b>Location</b>	Greeb Point	<b>Coordinate reference system</b>	WGS84	<b>Wind direction</b>	E	
<b>Survey Type</b>	INT	<b>Position Fix</b>	Handheld GPS	<b>Wind speed</b>	15-30 mph	
<b>IFCA officers</b>	AJ & SS	<b>Horizontal Accuracy</b>	Approx 6m	<b>Beaufort scale</b>	5	
<b>Others</b>	None	<b>Time zone</b>	UTC	<b>Cloud coverage</b>	2/8	<i>Data entered by:</i>
<b>Low water time</b>	12:58 (BST)	<b>Time start</b>	10:59	<b>Pressure</b>	1019 mb	SS (2023-04-25)
<b>Low water (m)</b>	0.09	<b>Time end</b>	12:41	<b>Air temperature</b>	12 °C	<i>QA by:</i>
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	N/A	<b>Water temperature</b>	12.7 °C	AJ (2023-04-05)
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 46 live brown crabs were recorded as part of the survey					
<b>Notes</b>	A lot more sand and stones was noticeable at survey site after strong winds. Underside of some rocks looked cleaner e.g. less keel worms.					
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
10:24		Arrive Greeb Point				
10:59	INT	Location 1 Start				
12:41	INT	Location 1 End				
13:10		Depart Greeb Point				



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## Daily log 11

Annex Table K: Daily log for 5th June 2023.

<b>Project</b>	Intertidal Survey for edible crabs		<b>Survey code</b>	20230605_CIFCA_INT_GRE		
<b>Date</b>	05/06/2023	<b>GPS &amp; Time:</b>		<b>Weather Recorded</b>	11:00 (UTC)	
<b>Location</b>	Greeb Point	<b>Coordinate reference system</b>	WGS84	<b>Wind direction</b>	E	
<b>Survey Type</b>	INT	<b>Position Fix</b>	Handheld GPS	<b>Wind speed</b>	11-15 mph	
<b>IFCA officers</b>	AJ & SS	<b>Horizontal Accuracy</b>	Approx 6m	<b>Beaufort scale</b>	4	
<b>Others</b>	None	<b>Time zone</b>	UTC	<b>Cloud coverage</b>	1/8	<i>Data entered by:</i>
<b>Low water time</b>	13:21 (BST)	<b>Time start</b>	11:23	<b>Pressure</b>	1023 mb	SS (2023-06-06)
<b>Low water (m)</b>	0.65	<b>Time end</b>	12:54	<b>Air temperature</b>	17 °C	<i>QA by:</i>
<b>Tide recorded from</b>	Falmouth	<b>Safety talk time</b>	N/A	<b>Water temperature</b>	19 °C	AJ (2023-06-06)
<b>Description of survey</b>	Intertidal survey for edible brown crab at Greeb Point, near Portscatho on the S coast of Cornwall. 34 live brown crabs were recorded as part of the survey					
<b>Notes</b>	Increase in algae coverage - wrack and sargassum					
<b>Time</b>	<b>Type</b>	<b>Details/description</b>				
10:50		Arrive Greeb Point				
11:23	INT	Location 1 Start				
12:54	INT	Location 1 End				
13:21		Depart Greeb Point				

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## Annex 2 – Survey data

A total of 65 edible crabs were measured and recorded during the survey on 29<sup>th</sup> April 2021 (Annex Table L).

Annex Table L: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 29<sup>th</sup> April 2021.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	58	U	
2	37	U	
3	45	U	Cracked carapace
4	40	U	
5	27	U	
6	35	U	
7	17	U	
8	12	U	
9	44	U	
10	39	U	
11	25	U	Dead - recent moult?
12	20	U	No claws
13	21	U	
14	48	U	Recently moulted
15	35	U	
16	30	U	
17	19	U	
18	22	U	
19	16	U	
20	22	U	
21	22	U	
22	15	U	
23	26	U	
24	16	U	
25	17	U	
26	12	U	
27	25	U	One claw
28	68	M	
29	40	U	
30	49	U	
31	16	U	
32	20	U	
33	57	U	
34	25	U	Dead - recent moult? One claw mangled
35	27	U	
36	31	U	Cracked carapace
37	16	U	
38	31	U	
39	21	U	Light orange carapace
40	41	U	
41	30	U	
42	20	U	
43	19	U	
44	35	U	
45	28	U	
46	58	U	
47	28	U	

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48	19	U	
49	30	U	
50	17	U	
51	40	U	
52	34	U	Dead - recent moult?
53	41	U	
54	31	U	
55	59	U	
56	37	U	
57	36	U	
58	68	F	
59	43	U	
60	28	U	
61	26	U	
62	50	U	
63	27	U	
64	30	U	One claw
65	92	F	Freshly moulted - Moulded shell carapace 71 mm

A total of 37 edible crabs were measured and recorded during the survey on 27<sup>th</sup> May 2021 (Annex Table M).

Annex Table M: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 27<sup>th</sup> May 2021.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	40	U	
2	23	U	
3	18	U	
4	41	U	
5	26	U	
6	55	U	Moult 45 mm
7	20	U	
8	68	M	
9	49	U	
10	62	F	
11	47	U	
12	71	M	
13	25	U	
14	39	U	
15	30	U	
16	58	U	
17	25	U	
18	60	M	
19	19	U	
20	23	U	
21	38	U	
22	65	F	
23	30	U	
24	21	U	
25	22	U	
26	16	U	No photo
27	38	U	
28	18	U	



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29	22	U	Moult 17 mm
30	36	U	
31	33	U	
32	23	U	
33	69	M	
34	25	U	
35	28	U	
36	22	U	
37	77	U	Dead. Moult? No photo

A total of 35 edible crabs were measured and recorded during the survey on 23<sup>rd</sup> June 2021 (Annex Table N).

Annex Table N: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 23<sup>rd</sup> June 2021.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	16	U	
2	46	U	
3	42	U	
4	59	U	
5	43	U	
6	17	U	
7	43	U	
8	33	U	
9	38	U	
10	42	U	
11	68	M	
12	39	U	
13	39	U	
14	62	F	
15	48	U	
16	37	U	
17	59	U	
18	24	U	
19	102	M	
20	26	U	
21	25	U	
22	19	U	Cracked carapace
23	49	U	
24	18	U	
25	64	F	
26	54	U	
27	38	U	
28	36	U	
29	19	U	Damage to edge of carapace
30	46	U	No photo
31	48	U	Recently moulted
32	65	F	
33	57	U	
34	56	U	
35	41	U	

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A total of 18 edible crabs were measured and recorded during the survey on 8<sup>th</sup> October 2021 (Annex Table O).

Annex Table O: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 8<sup>th</sup> October 2021.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	70	M	Freshly moulted - Moulded shell carapace 56 mm
2	59	U	
3	20	U	
4	72	F	
5	72	F	
6	51	U	
7	46	U	
8	19	U	
9	30	U	Freshly moulted - Moulded shell carapace 24 mm
10	29	U	
11	55	U	
12	32	U	
13	53	U	
14	42	U	
15	73	M	
16	55	U	
17	51	U	
18	24	U	

A total of 43 edible crabs were measured and recorded during the survey on 3<sup>rd</sup> March 2022 (Annex Table P).

Annex Table P: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 3<sup>rd</sup> March 2022.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	14	U	Claw missing
2	29	U	
3	20	U	
4	32	U	
5	37	U	
6	13	U	
7	40	U	
8	37	U	
9	28	U	
10	21	U	Damaged carapace
11	28	U	
12	26	U	
13	21	U	
14	61	M	
15	12	U	
16	27	U	
17	28	U	
18	156	U	Newly moulted
19	33	U	
20	39	U	
21	71	F	

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22	66	F	
23	82	M	
24	30	U	
25	47	U	
26	66	F	
27	27	U	
28	12	U	
29	52	U	
30	19	U	White carapace. No photo
31	33	U	
32	39	U	
33	60	F	
34	39	U	No photo
35	76	M	
36	33	U	
37	31	U	
38	29	U	Damaged carapace
39	39	U	
40	32	U	
41	52	U	
42	30	U	
43	39	U	
-	-	-	Dead edible crab (77mm)

A total of 56 edible crabs were measured and recorded during the survey on 31<sup>st</sup> March 2022 (Annex Table Q).

Annex Table Q: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 31<sup>st</sup> March 2022.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	30	U	
2	14	U	Broken carapace
3	12	U	
4	50	U	
5	77	F	
6	78	F	
7	54	U	
8	68	M	
9	20	U	
10	32	U	
11	26	U	
12	25	U	Very soft shell
13	63	M	1 claw
14	33	U	1 claw
15	40	U	1 claw
16	30	U	Soft shell, regrowing 1 claw
17	16	U	
18	28	U	
19	77	M	
20	78	F	Regrowing 1 claw
21	48	U	
22	40	U	2 legs missing
23	38	U	



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24	71	F	
25	70	F	
26	63	F	
27	94	F	Very soft shell
28	42	U	
29	43	U	
30	27	U	
31	18	U	
32	28	U	
33	37	U	
34	35	U	
35	21	U	
36	43	U	
37	35	U	
38	32	U	
39	11	U	
40	30	U	
41	19	U	
42	18	U	
43	61	F	
44	52	U	
45	12	U	
46	16	U	
47	17	U	
48	16	U	
49	27	U	
50	18	U	
51	18	U	
52	19	U	
53	19	U	
54	38	U	
55	31	U	
56	27	U	

A total of 41 edible crabs were measured and recorded during the survey on 15<sup>th</sup> June 2022 (Annex Table R).

Annex Table R: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 15<sup>th</sup> June 2022.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	34	U	1 claw
2	75	F	
3	42	U	
4	28	U	
5	79	F	
6	39	U	
7	64	F	
8	37	U	
9	46	U	
10	69	F	
11	73	F	
12	39	U	
13	42	U	

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14	73	M	
15	32	U	
16	56	U	
17	42	U	
18	36	U	
19	75	M	
20	29	U	
21	21	U	
22	36	U	
23	66	M	
24	38	U	
25	57	U	
26	57	U	
27	60	M	
28	45	U	
29	50	U	
30	43	U	
31	25	U	
32	59	U	
33	54	U	
34	77	F	
35	40	U	
36	76	M	
37	86	F	
38	55	U	
39	58	U	
40	25	U	
41	40	U	

A total of 29 edible crabs were measured and recorded during the survey on 14<sup>th</sup> July 2022 (Annex Table S).

Annex Table S: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 14<sup>th</sup> July 2022.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	44	U	
2	53	U	
3	67	F	
4	66	M	
5	58	U	
6	40	U	
7	80	M	
8	61	F	
9	82	M	
10	65	M	
11	62	M	
12	55	U	
13	66	F	
14	61	F	
15	97	F	
16	59	U	
17	46	U	Freshly moulted - Moulded shell carapace 35 mm
18	47	U	

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19	30	U	
20	24	U	
21	54	U	
22	89	F	Freshly moulted - Moulded shell carapace 69 mm
23	70	F	
24	67	F	
25	46	U	
26	55	U	
27	58	U	
28	29	U	
29	41	U	

A total of 35 edible crabs were measured and recorded during the survey on 21<sup>st</sup> March 2023 (Annex Table T).

Annex Table T: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U – Unsexed, M – Male and F - Female) and notes from the survey on 21st March 2023.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	23	U	Two legs missing
2	19	U	
3	26	U	Cracked carapace
4	53	U	
5	53	U	
6	56	U	
7	71	F	
8	50	U	
9	23	U	
10	18	U	Soft shell, found next to 13mm moult 38.5% inc (see photos)
11	77	F	
12	91	F	
13	16	U	
14	38	U	
15	16	U	
16	24	U	
17	45	U	
18	31	U	
19	23	U	
20	16	U	
21	36	U	
22	12	U	
23	82	F	
24	23	U	
25	49	U	
26	34	U	
27	81	F	
28	57	U	Soft shell
29	82	M	
30	42	U	
31	35	U	
32	68	F	
33	25	U	
34	43	U	

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35	46	U	
-	-	U	Dead edible crab (44 mm)
-	-	U	Dead edible crab (40 mm)

A total of 46 edible crabs were measured and recorded during the survey on 20<sup>th</sup> April 2023 (Annex Table U).

Annex Table U: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 20th April 2023.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	42	U	
2	38	U	
3	31	U	
4	52	U	
5	32	U	
6	33	U	
7	50	U	1 claw missing
8	53	U	
9	41	U	
10	63	F	
11	16	U	
12	50	U	
13	78	U	Hiding in crack - no photo
14	41	U	
15	70	M	
16	42	U	1 claw missing
17	76	F	
18	88	M	
19	63	F	
20	21	U	
21	35	U	
22	26	U	
23	16	U	
24	46	U	White carapace
25	23	U	1 leg missing
26	16	U	
27	20	U	Left side 4 legs and claw missing
28	15	U	
29	74	M	
30	86	F	Soft shelled, 1 claw missing
31	60	F	
32	75	F	
33	78	F	
34	52	U	
35	74	F	1 leg missing
36	41	U	
37	14	U	
38	48	U	
39	12	U	
40	22	U	
41	10	U	
42	14	U	1 claw missing
43	64	M	



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44	42	U	Leg missing
45	22	U	
46	21	U	

A total of 34 edible crabs were measured and recorded during the survey on 5<sup>th</sup> June 2023 (Annex Table V).

Annex Table V: The edible crab (*Cancer pagurus*) records including carapace size (mm), sex (U - Unsexed, M – Male and F - Female) and notes from the survey on 5th June 2023.

Crab No.	Carapace size (mm)	Sex (M/F/U)	Other
1	93	U	
2	29	U	
3	30	U	
4	55	U	
5	24	U	
6	31	U	
7	25	U	
8	38	U	Cracked carapace
9	24	U	
10	82	U	
11	40	U	
12	67	U	
13	65	U	
14	86	U	
15	62	U	
16	83	U	
17	67	U	
18	43	U	Soft
19	62	U	
20	37	U	
21	45	U	
22	19	U	1 claw
23	48	U	
24	11	U	Banding on legs
25	32	U	Soft shell
26	31	U	1 claw
27	28	U	
28	60	M	
29	87	F	1 leg missing
30	87	F	
31	81	M	
32	38	U	
33	56	U	
34	84	F	1 claw