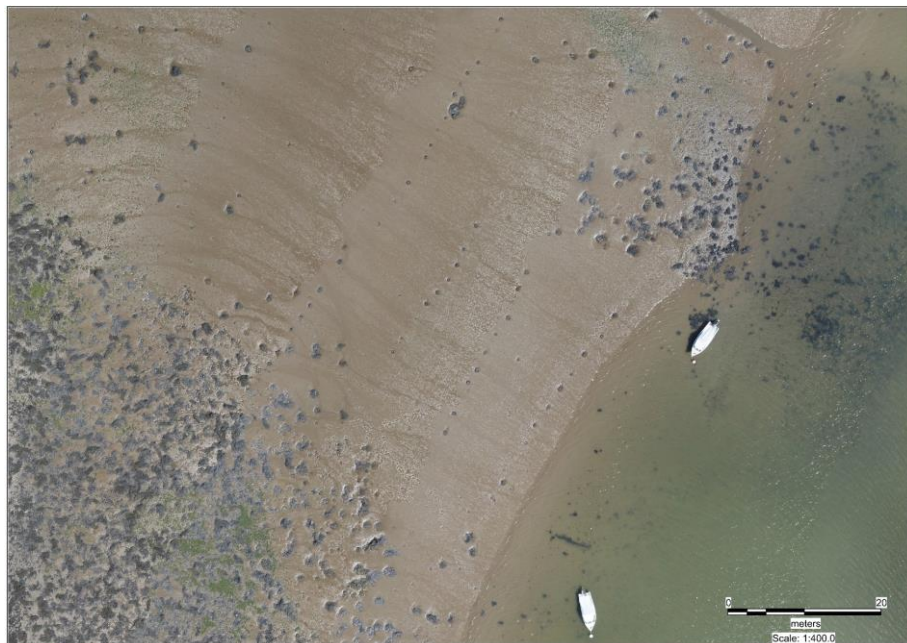




## Crab Tile Survey within the River Tamar 2020



Final report for the 2020 Crab Tile Survey within the Tamar Estuary  
(2020\_CIFCA\_Tamar\_UAV)

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA)

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**Document Control**

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## Summary

Crab tiles are made up of various objects (e.g. sections of plastic guttering) which are placed in the intertidal as a form of artificial habitat to attract moulting crabs seeking shelter. The soft-shelled crabs are then collected and used as angling bait. Crab tile numbers have been monitored since 2000 on the Tamar Estuary and recently this has been carried out using a drone where individual crab tiles are counted from the aerial imagery. In 2020, 7,173 tiles were recorded which was a 1% increase since 2017.

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## 1 Introduction

Crab tiling, or crab potting as it is sometimes referred to locally, is a method of collecting shore crabs (*Carcinus maenas*) which are hiding underneath crab tiles so they can be used as bait for anglers. Like all other crustaceans, shore crabs moult their shells at regular intervals throughout their lives and will seek shelter when they go through this process. Bait collectors, known as ‘crab tilers’ exploit this behaviour by providing artificial habitats using hard, man-made structures, such as pieces of half round guttering, drain pipes, tyres and roof tiles, examples of crab tiles within the Tamar Estuary are shown in Figure 1. The soft shelled crabs, known as peeler crabs, are collected at low tide (preferably spring low tide) when the tiles are accessible. Crab tiling has been documented within the Tamar Estuary since the 1990s (Godden, 1995). Crab tiles have the potential to change habitat complexity, benthic infaunal diversity and abundance, as well as bird behaviour over large areas (Sheehan *et al.*, 2010).



Figure 1: Crab tiles within the Tamar Estuary (left image: plastic guttering as crab tile and right image: rows of crab tiles from aerial imagery). (Source: Cornwall IFCA)

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA) have a responsibility to manage the exploitation of sea fisheries resources under the Marine and Coastal Access Act 2009 (MaCAA) which includes crab tiling. Crab tiling is mainly a recreational activity but there can be a commercial element when crabs are sold on. The Tamar Estuary falls within the jurisdiction of both Cornwall IFCA and Devon and Severn IFCA. Currently no statutory or voluntary measures have been implemented for crab tiling on the Tamar Estuary.

Cornwall IFCA aim to carry out a crab tiling survey within the Tamar Estuary every four years. This is to enable the number and location of crab tiles to be assessed over time. The crab tiles within the Cornwall IFCA District, in the Tamar Estuary, were last surveyed in 2017. This survey of the Tamar Estuary only covers the Cornwall IFCA District, namely the River Tamar and River Lynher, Parkhouse (2021) details crab tiles within the Devon & Severn IFCA District of the Tamar Estuary.

A number of designations exist in the Tamar Estuary which includes the Tamar Estuary Sites Marine Conservation Zone (MCZ), the Plymouth Sound and Estuaries Special Area of Conservation (SAC), Tamar Estuaries Complex Special Protection Area (SPA), St. John's Lake Site of Special Scientific Interest (SSSI), Lynher Estuary SSSI and the Tamar – Tavy Estuary SSSI (Annex Figure A).

## 2 Aims and objectives

### 2.1 Aims

- Monitor the number of crab tiles within the Tamar Estuary.

### 2.2 Objectives

- Repeat areas surveyed in 2017 to assess the number of crab tiles.
- Verify crab tiles from aerial imagery.
- Compare results from this survey with previous years.

## 3 Methodology

An Unmanned Aerial Vehicle (UAV) or drone, as they are commonly referred to, was used to collect images to map the areas of crab tiles. This was operated by Duncan Hine of Vertical Horizons Media. The survey was carried out over a four hour time frame, two hours either side of low water, on spring tides between 17<sup>th</sup> and 21<sup>st</sup> May 2020. The areas surveyed were based on locations from the previous surveys in 2012 (Noble, 2013) and 2017 (Jenkin *et al.*, 2017). Site maps were provided by Cornwall IFCA based on the 2017 data which showed the areas to be surveyed. The UAV operator programmed flight paths into the drone for each location of the survey. The drone was flown at an altitude of 40 m, recording the GPS track and taking a still image every few seconds to achieve a target ground spacing distance of 0.9 cm/ pixel. The technical specification of the drone can be found in Annex 2. The drone could be manually overridden by the operator when necessary to avoid obstacles or during windy periods.

The images from the survey were then processed by the drone operator using the processing software; Mission Planner and Pix4D. The software Pix4D stitches together the imaging and creates geo-tiles. These geo-tiles (raster images) were imported into MapInfo Professional Advanced (Version 17.0.4) and used to count the crab tiles. To do this the area was first scanned at a 1:200 cartographic scale to look for evidence of tiles present by identifying footprints to areas with uniform rows of equal spacing between objects and pools of water surrounding each object. Individual crab tiles were identified at a cartographic scale of 1:50. Where possible, a polyline was drawn from the start to the end of each row of tiles, with a node made for each crab tile. Or if the distribution was irregular a polygon was created to show the perimeter of patches and points were created for each crab tile within the polygon. Each node of a polyline and point within a polygon were created in Latitude/ Longitude WGS84 projection. The total numbers of tiles were then calculated for each vector feature. Attribute data including location, site identification, number of tiles, number of rows, usage and any other comments were recorded within the layer table. This layer was used to compare results with previous survey layers.



## 4 Results

The drone flights were successful in obtaining aerial imagery of the areas which contained crab tiles in 2012 and 2017, covering a total area of 126 ha. Crab tile polylines covered a total distance of 11.9 km and polygons covered a total of 1.9 ha. The results can be seen in Figure 4 to Figure 16, which show the crab tile distribution and counts for 2020 and 2017 over the aerial imagery.

A total of 7,173 crab tiles were recorded in the Tamar Estuary (Cornwall IFCA District only). This was a 1% increase since the 2017 survey. Table 1 shows the difference in numbers of crab tiles since 2000.

Table 1: Comparison of crab tile counts in 2020 from previous surveys in the Tamar Estuary

Survey	Number of crab tiles	Difference	Percentage difference
<b>2020</b>	7,173	+90	1%
<b>2017</b>	7,083	+852	14%
<b>2012</b> (Noble, 2013)	6,231	+3,441	123%
<b>2003/04</b> (Black, 2004)	2,790	+755	37%
<b>2000/01</b> (Black, 2004)	2,035	-	-

Table 2 shows the increase in tiles since 2017 was primarily down to a significant increase in Sand Acre Bay (TAM04) and near Redshank Point (TAM00). The area near Redshank Point (TAM00) is partly due to increase in aerial imagery coverage. Palmer Point (TAM37) saw the greatest decrease in the number of tiles.

Table 2: Breakdown of crab tile counts and distribution in the Tamar Estuary (\*tiles missing from total counts)

Estuary	Location	Area	2020 Tiles	2017 Tiles	2012 Tiles	2003/04 Tiles	2000/01 Tiles	Count difference (2020-2017)	Percentage difference (2020-2017)
Lynher	South & West of Redshank Point	TAM00	1,098	926*	1,269	200	0	+172	19%
	Warren Point	TAM01	761	715	814	741	532	+46	6%
	Juipter Point	TAM02	0	0	0	0	8	-	-
	Antony Passage	TAM03	0	0	0	0	43	-	-
	Sand Acre Bay	TAM04	657	406	415	840	834	+251	62%
	Tredown Lake	TAM27	232	218	262	0	0	+14	6%
Tamar	Saltash	TAM05	420	400	254	340	108	+20	5%
	Saltmill Creek	TAM06	706	630	635	327	314	+76	12%
		TAM23	0	0	0	92	0	-	-
	Cargreen to Neal Point	TAM24	349	298*	160	250	0	+51	17%
	Torpoint	TAM16	0	0	0	0	79	-	-
		TAM25	669	626	580	0	0	+43	7%
	Thanckes Lake	TAM26	1,475	1,729	1,316	0	0	-254	-15%
	Southdown	TAM17	0	0	0	0	117	-	-
Palmer Point	TAM37	806	1,135	526	0	0	-329	-29%	
<b>TOTAL</b>			<b>7,173</b>	<b>7,083</b>	<b>6,231</b>	<b>2,790</b>	<b>2,035</b>	<b>+90</b>	<b>1%</b>

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Overall, since 2017, the main changes in 2020 were to the overall counts of crab tile lines and slight alterations to the distributions.

An area on the River Lynher, near Redshank Point, had a high voltage power line which obstructed the drone's coverage in 2017, however this area was able to be covered in 2020 (TAM00, Figure 2 and Figure 3 Figure 2) and all tiles previously recorded in 2012 are now believed to be accounted for in this area.

Tiles were believed to extend the 2017 line of 189 tiles north in the area south of Weir Point (TAM24, Figure 12) and this area was covered by the drone in 2020 increasing the line of crab tiles further north. Increase in aerial imagery extent also found new records of 42 tiles in Cargreen (TAM24, Figure 11) although no footprints could be seen to or near these tiles. A new line of 77 crab tiles was found north of Saltmill Creek (TAM06) following previous 2012 extent.

Tiles are thought to extend the aerial imagery north west of line of 15 tiles in west of Redshank Point (TAM00, Figure 2) and further east of lines of three tiles east of Warren Point (TAM01, Figure 5). Tiles are also believed to extend further south near Tredown Lake (TAM27, Figure 6).

Some tiles were not uncovered at low tide on the day of survey (namely area TAM04, Figure 7) but tiles could just be made out under the surface of the water and the majority were thought to be accounted for.

No crab tiles were seen in the 2020 aerial imagery, near the 2017 polygon of 365 tiles north of Yonderberry Point (TAM26, Figure 12).

Usage was recorded where possible from the aerial imagery, out of the 127 vector features recorded; 77 had footprints to and around the tiles, 14 had footprints nearby and 36 had no recent footprints to tiles or nearby. Additionally, 25 of the vector features were difficult to distinguish the tiles, either due to being covered in seaweed or buried and therefore hard to identify apart from rocks.

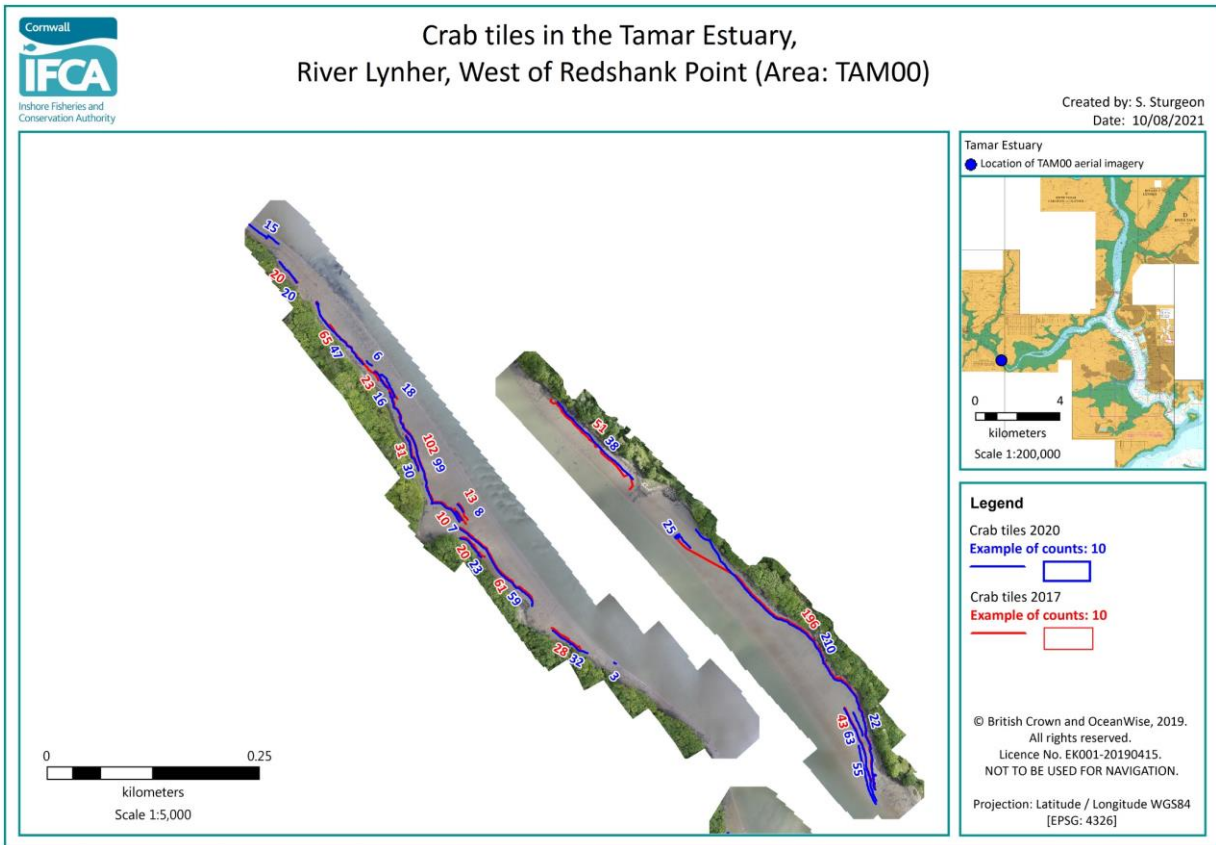


Figure 2: Crab tiles in the River Lynher, west of Redshank Point (TAM00) 2017.

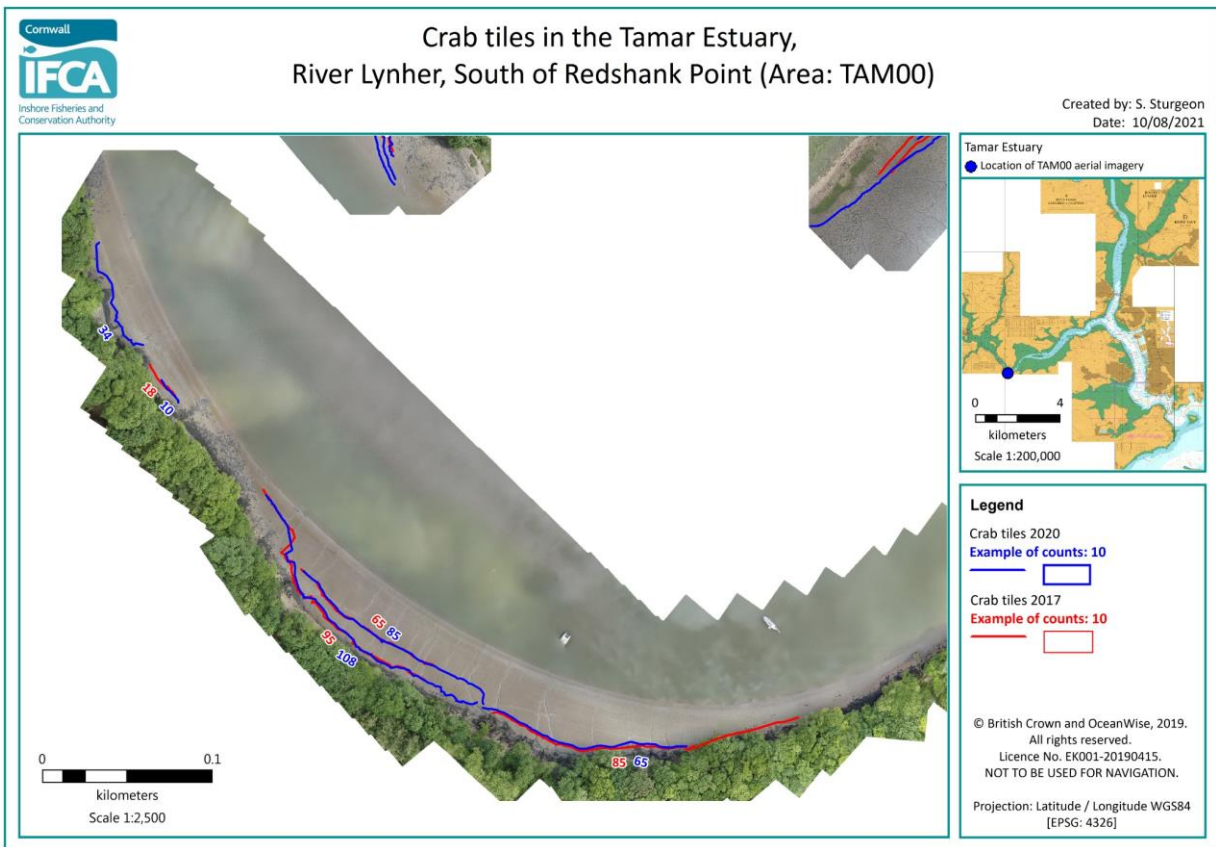


Figure 3: Crab tiles in the River Lynher, south of Redshank Point (TAM00) 2020.

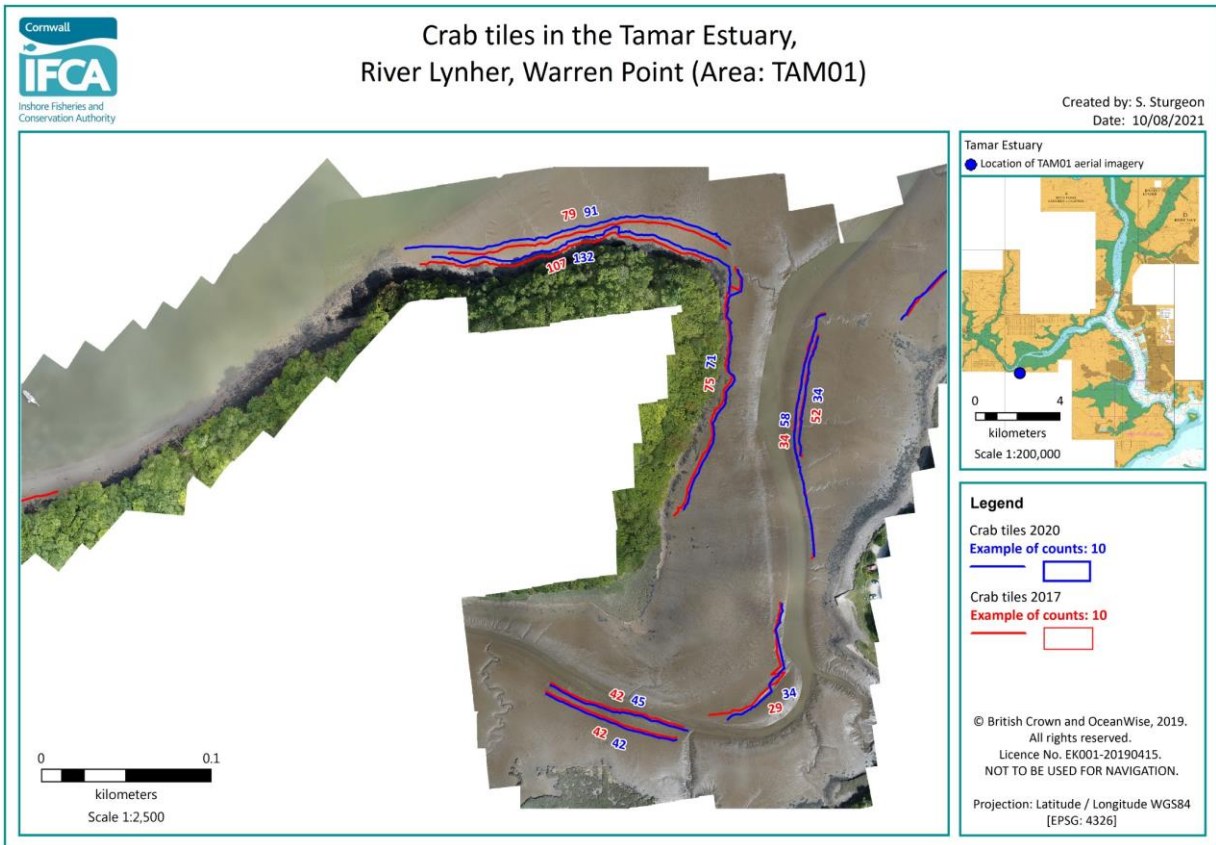


Figure 4: Crab tiles in the River Lynher, Warren Point (TAM01) 2020.

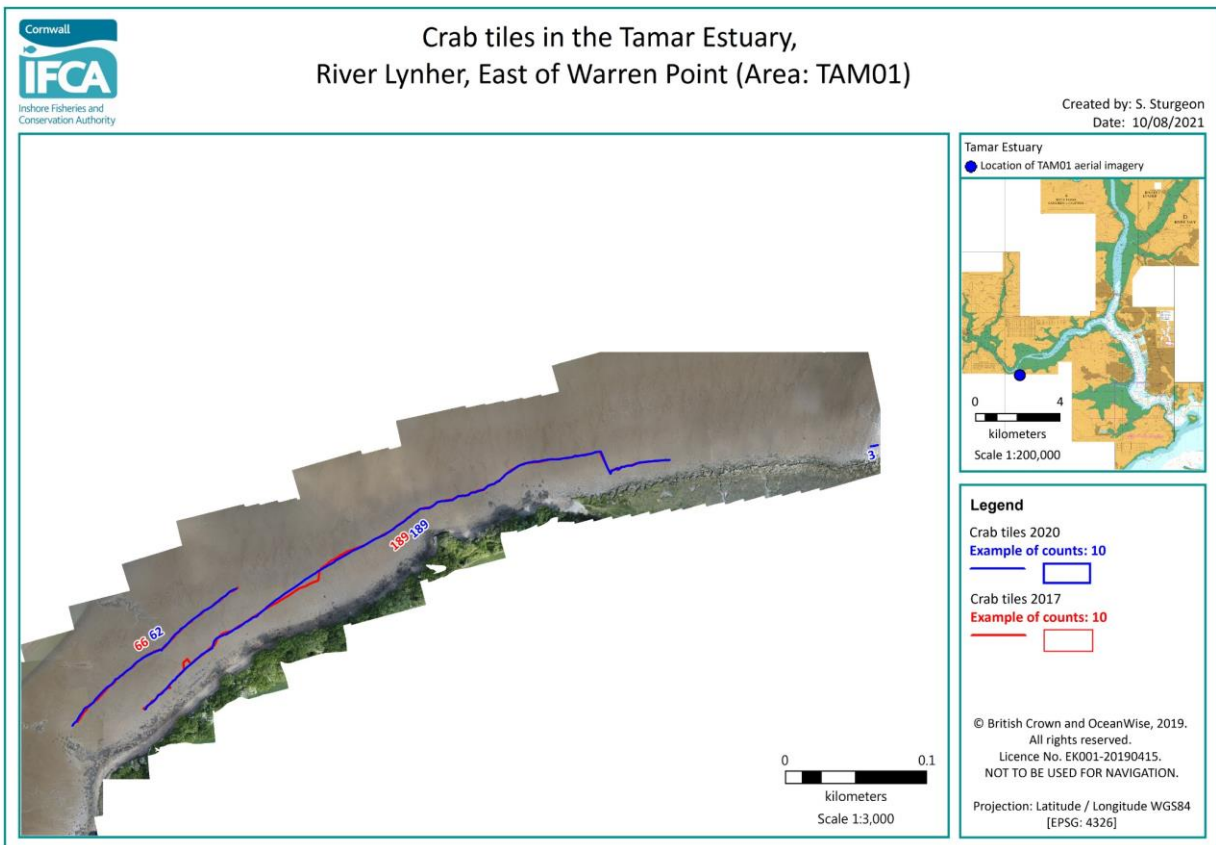


Figure 5: Crab tiles in the River Lynher, east of Warren Point (TAM01) 2020.



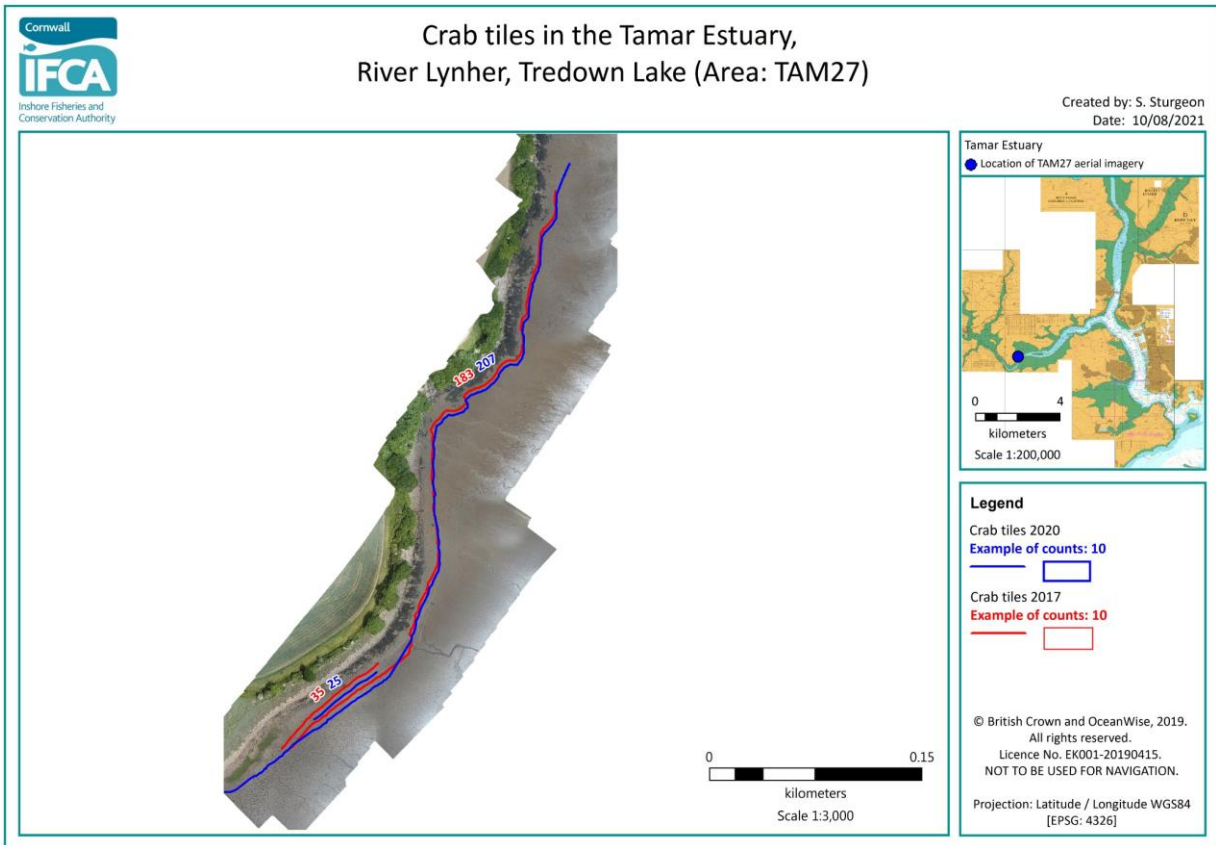


Figure 6: Crab tiles in the River Lynher, Tredown Lake (TAM27) 2020.

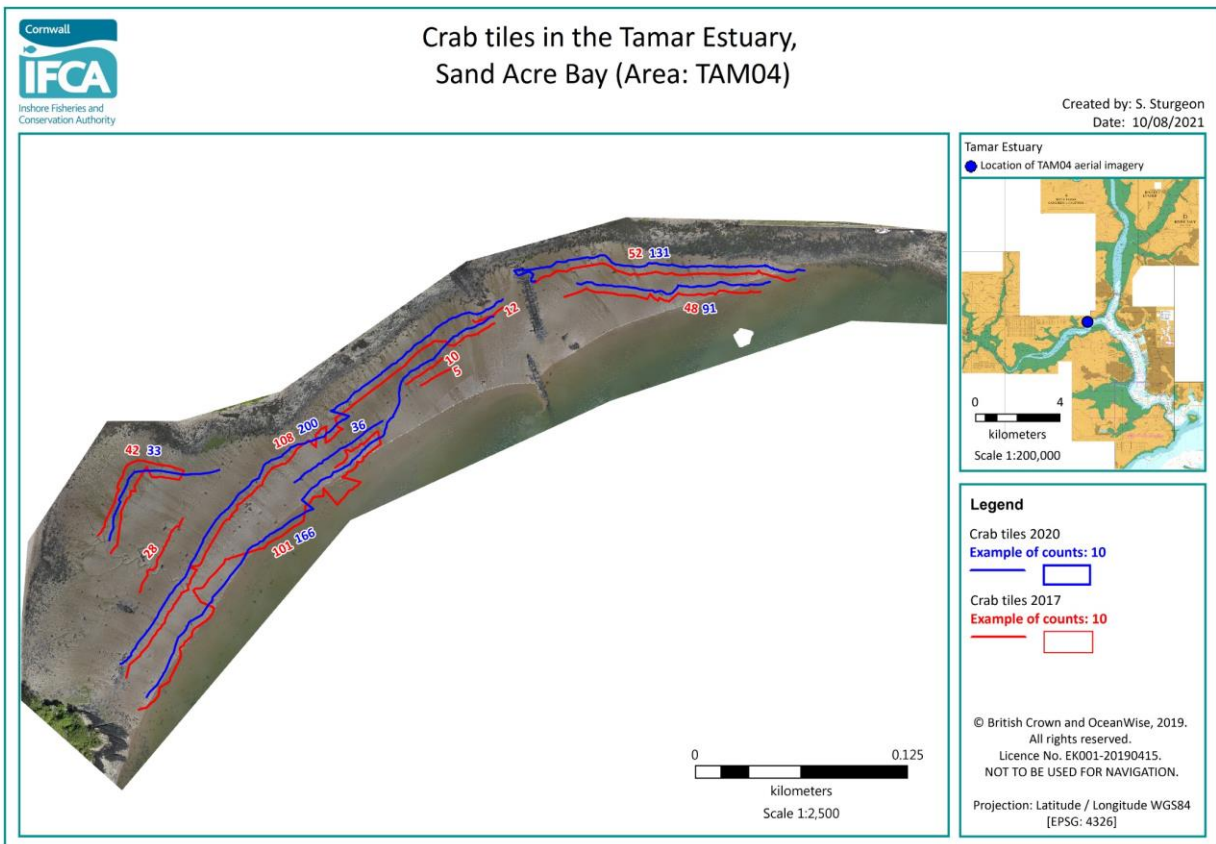


Figure 7: Crab tiles in the River Lynher, Sand Acre Bay (TAM04) 2020.

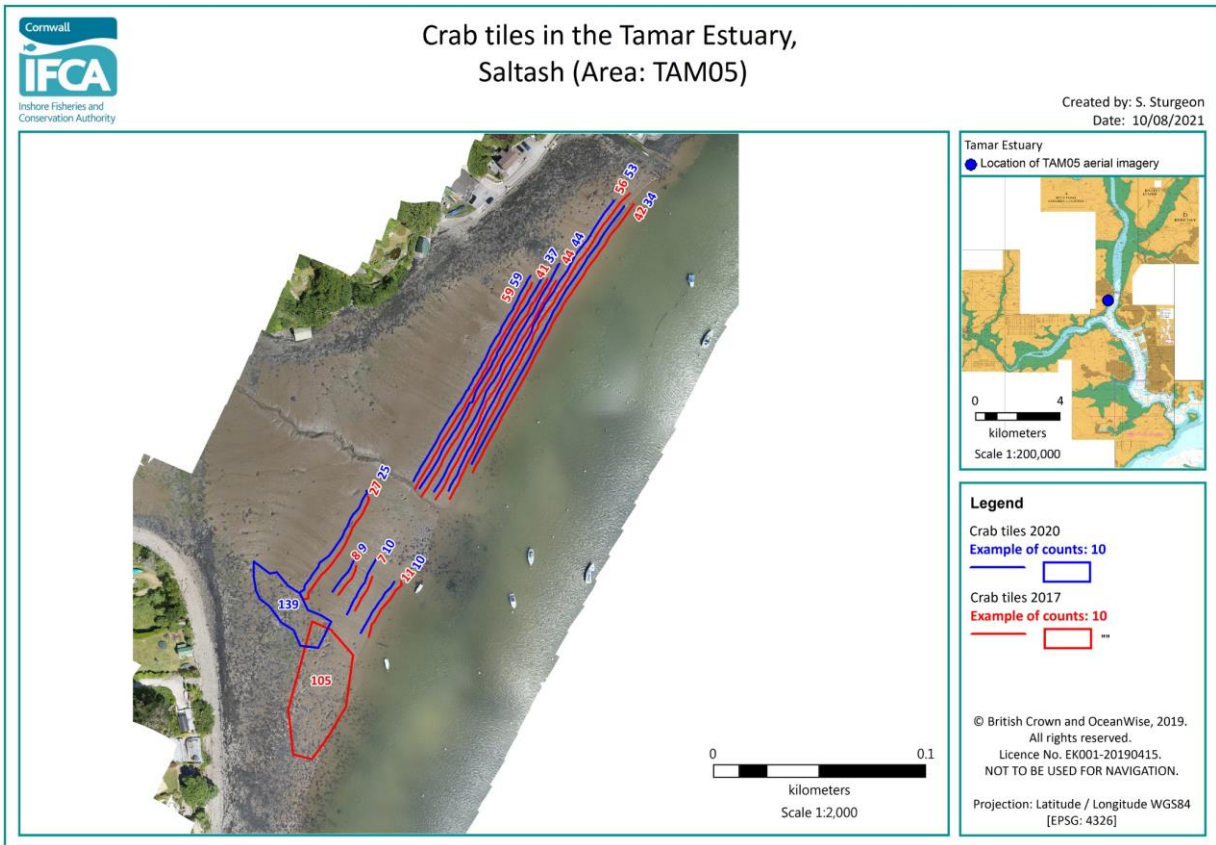


Figure 8: Crab tiles in the River Tamar, near Saltash (TAM05) 2020.

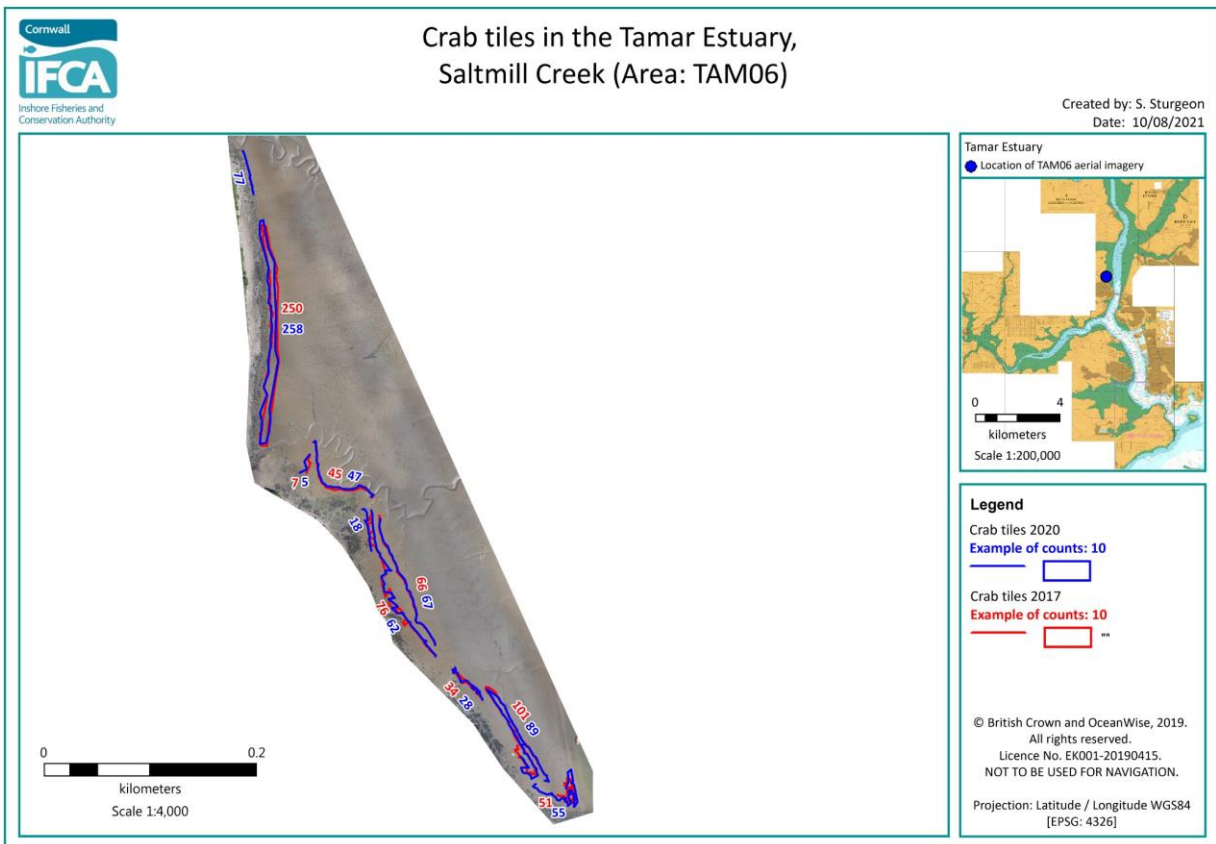


Figure 9: Crab tiles in the River Tamar, near Saltmill Creek (TAM06) 2020.

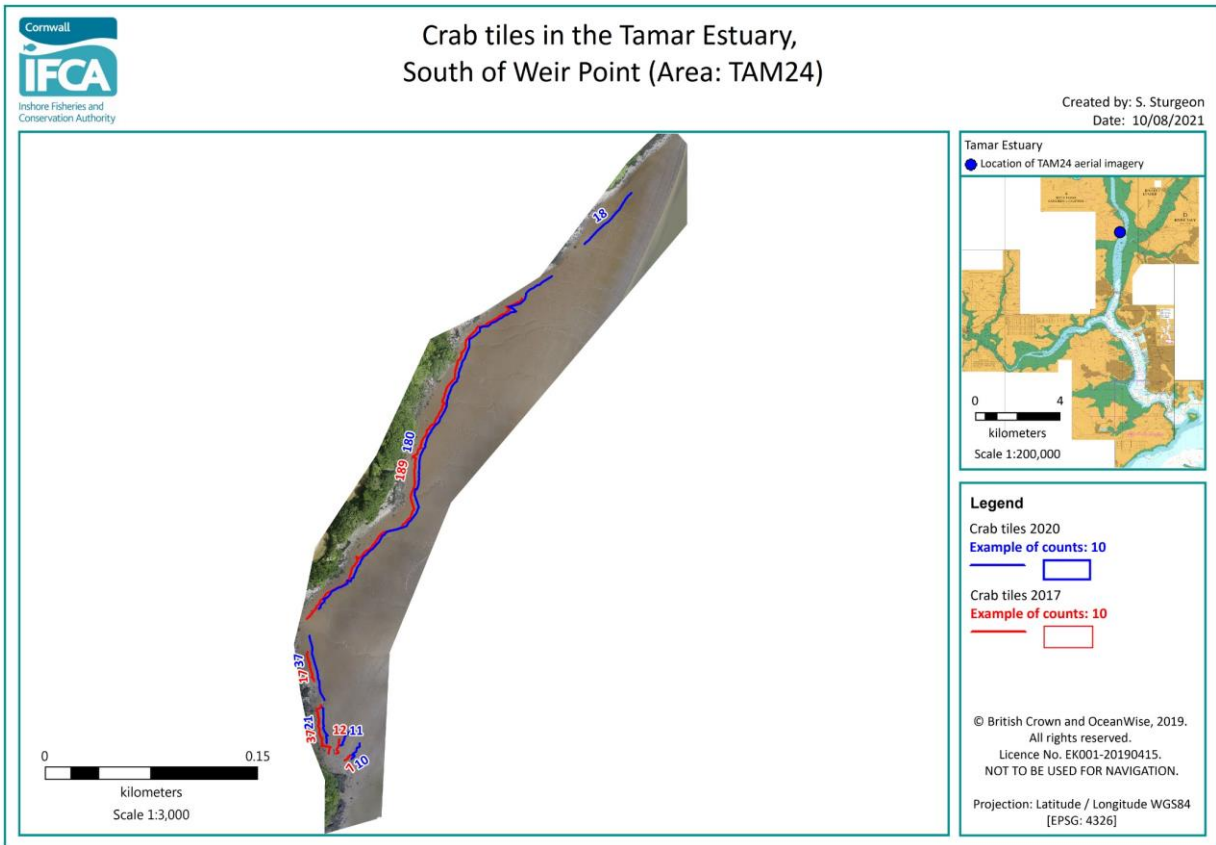


Figure 10: Crab tiles in the River Tamar, south of Weir Point (TAM24) 2020.

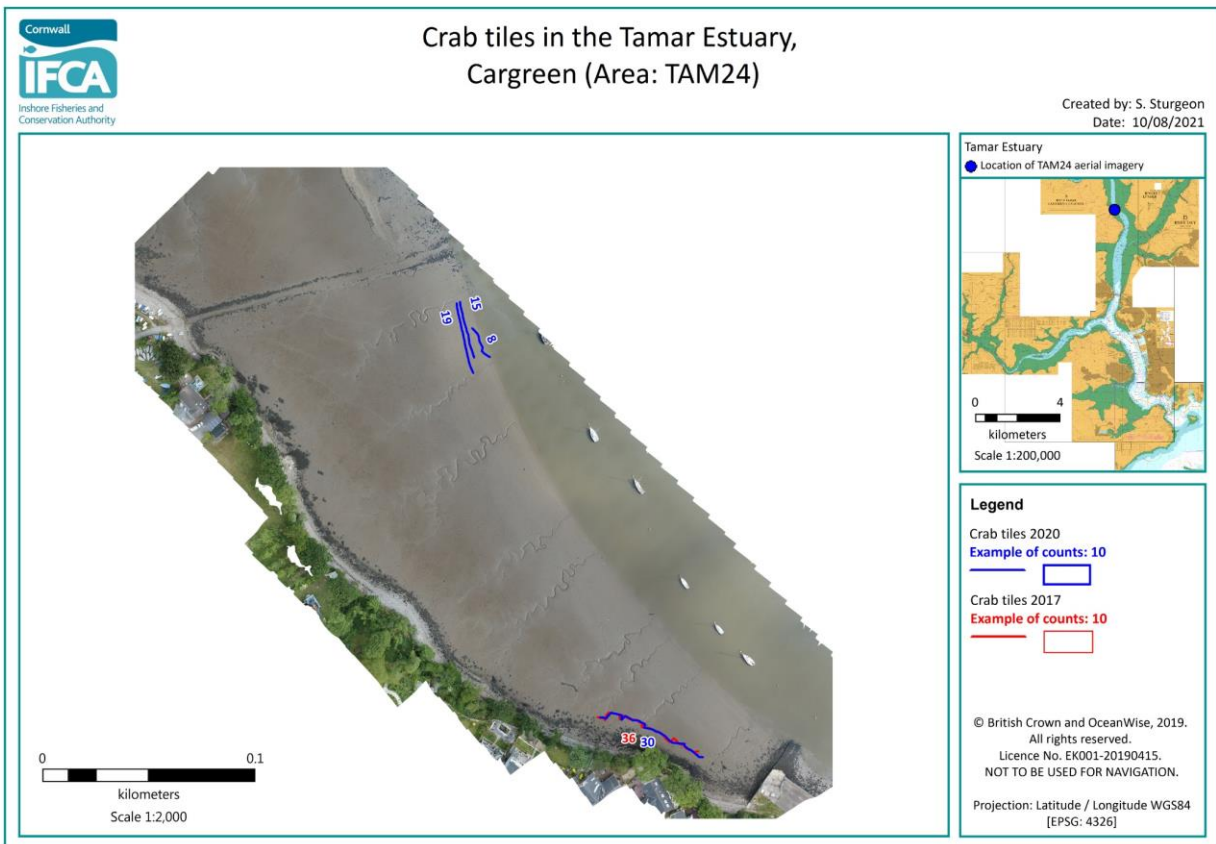


Figure 11: Crab tiles in the River Tamar, near Cargreen (TAM24) 2020.



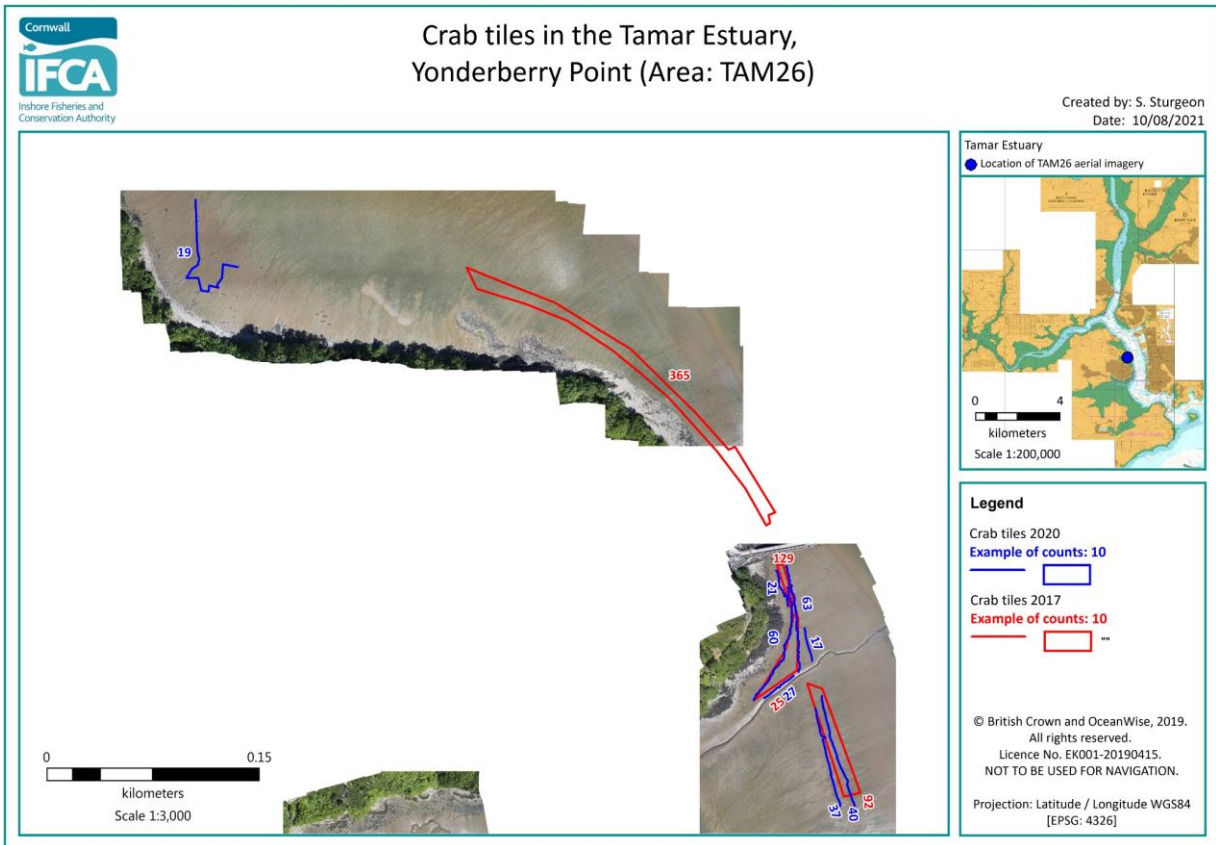


Figure 12: Crab tiles in the River Tamar, Yonderberry Point (TAM26) surveyed by foot 2017 and by drone in 2020.

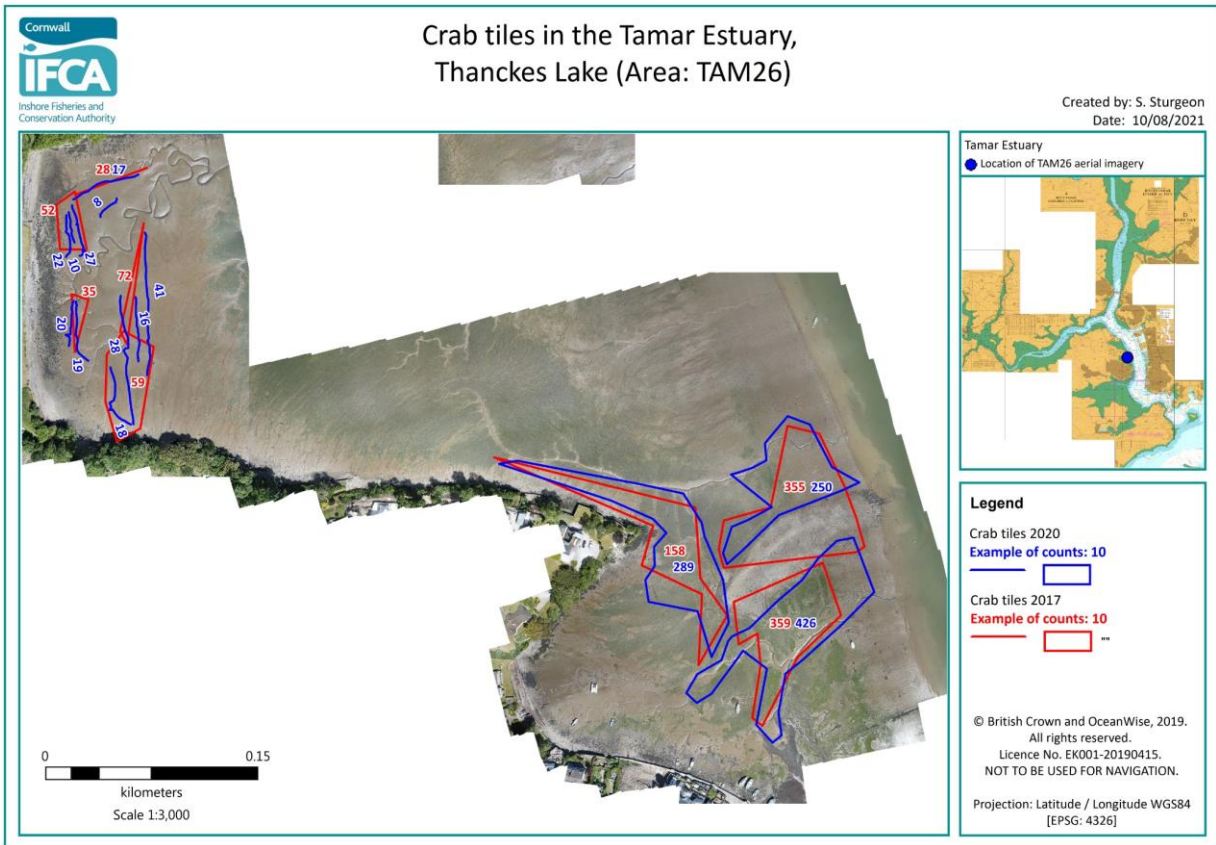


Figure 13: Crab tiles in the River Tamar, Thanckes Lake (TAM26) surveyed by foot 2017 and by drone in 2020.



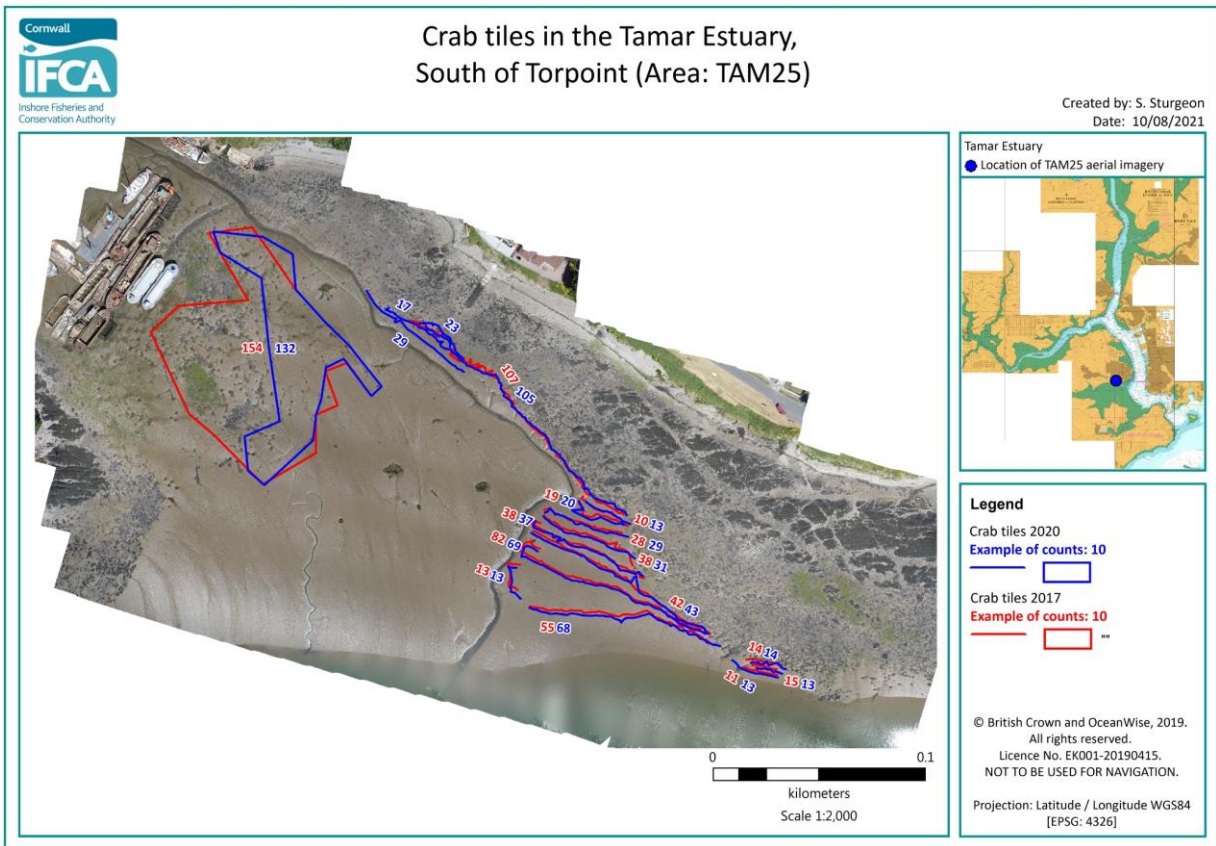


Figure 14: Crab tiles in the River Tamar, near Torpoint (TAM25) 2020.

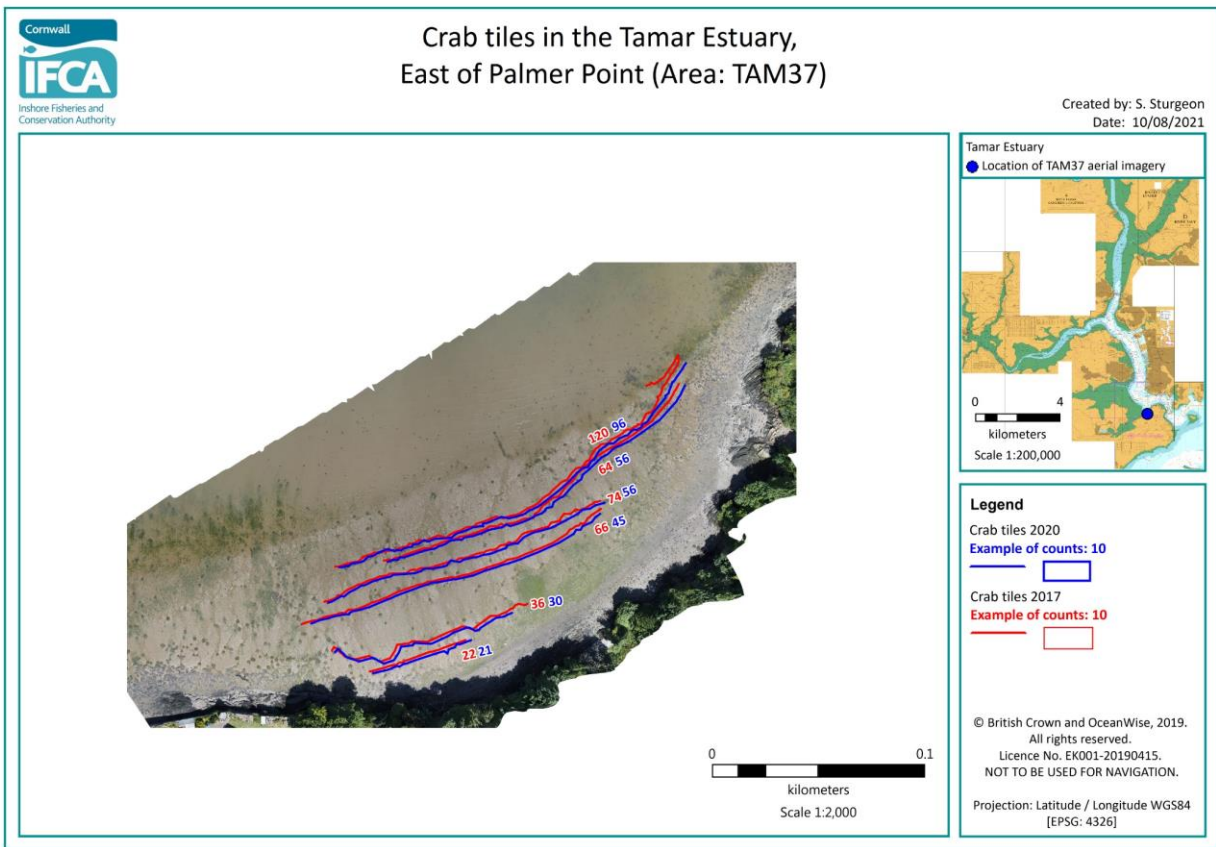


Figure 15: Crab tiles in the River Tamar, east of Palmer Point (TAM37) 2020.

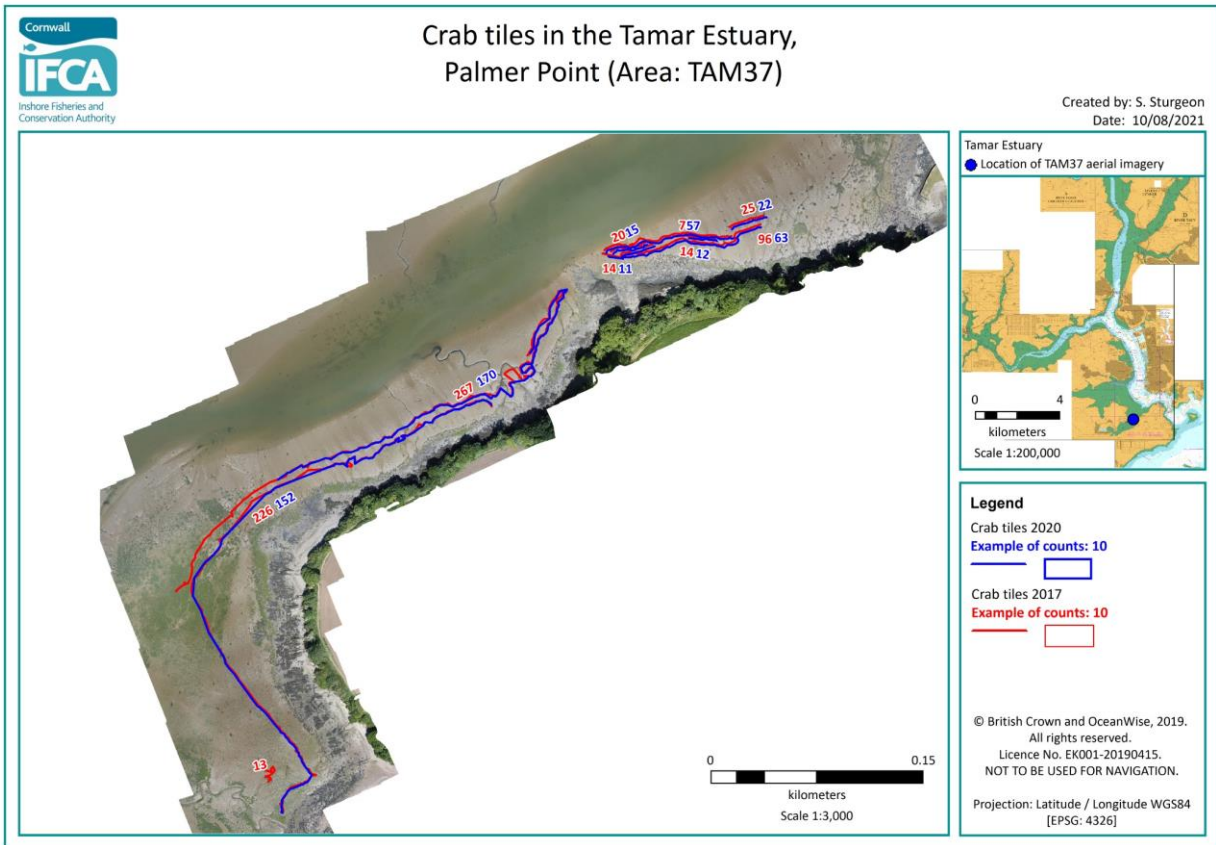


Figure 16: Crab tiles in the River Tamar, Palmer Point (TAM37) 2020.

## 5 Discussion

Crab tile numbers were relatively stable between 2000/01 (2,790) and 2003/04 (2,035). In 2012 they dramatically increased two-fold to 6,231 and a further 13%, to 7,083 in 2017. In 2020, 7,173 tiles were recorded which accounted for a 1% increase. The likely reason for the similar numbers between 2017 and 2020 is due to the increased accuracy of counts by using aerial imagery from the drone.

The crab tilers have a set area of tiles which is generally worked by an individual who owns them. There is a limit to the number of crab tiles which can be placed within an estuary due to the available habitat which is suitable for crab tiles. This may explain why there is no significant increase in the number of tiles recorded from 2017 to 2020.

In 2017 a foot survey was carried out near Thanckes Lake and a crab tiler who was met on site informed Cornwall IFCA officers that some of the crab tiles just off Yonderberry Point were no longer used but the rest of them in the area were still active. These tiles, north of Yonderberry Point were not present in the aerial imagery and must have been removed from the foreshore since 2017 (TAM26, Figure 12).

An undergraduate project by Godden (1995) reported the number of crab tiles in Plymouth raised in a few years from almost zero to 8,750. A few years later, in 1998, the Tamar Estuaries Bait Collection Working Group gave an estimate of around 20,000 crab tiles within the River Tamar, Plym, Lynher and Tavy (Fowler, 1999). The survey by Black (2004) reduced this estimated amount to an actual total count of 8,403 in 2000/01 and 8,165 in 2003/04. In 2012, the total raised to 12,870 tiles (Noble, 2013) and in 2016/17 12,757 tiles (Davies, 2017; Jenkin *et al.*, 2017). After the results of this survey and that of Devon and Severn IFCA, currently, there are a total of 15,340 crab tiles within the Plymouth Estuaries (Parkhouse, 2021).

### 5.1 Data limitations

When analysing the aerial imagery it was subject to personal judgement. In some areas it was difficult to determine the difference between crab tiles and rocks, namely in the polygons in Figure 8, Figure 9 and Figure 14 and for the whole areas of Figure 15 and Figure 16. Additionally, when crab tiles have not been worked for a while, they sink into the sediment becoming less visible and can be hard to identify without the signs of access in terms of footprint trails to and around them.

In the figures presented, disparity between the 2020 and 2017 layers can be seen with up to a 6 m difference in projection between the lines of crab tiles (example Figure 5). This is due to the raster images from 2020 and 2017 being in different projections (EPSG: 3857 and EPSG: 32630, respectively).

While Cornwall IFCA are not aware of any new tiles being placed in any other areas within the Tamar Estuary, new areas of crab tiles may have been overlooked as the drone flight path only used areas in which crab tiles were seen in 2017.

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## 5.2 Recommendations for future work

It is necessary that the crab tiling survey is continued so that the monitoring of crab tile numbers and distribution in the Tamar Estuary is maintained. The data collected informs Habitat Regulation Assessments (HRAs) for Plymouth Sound and Estuaries SAC and Tamar Estuaries Complex SPA as well as MCZ assessments for Tamar Estuary MCZ. It is important to monitor the activity and determine whether levels are environmentally sustainable for these sites.

Since the survey was carried out in May 2020, there have been reports of an increase in crab tiles within the Tamar, this may be due to more usage of the local area during lockdowns from COVID-19. It may be necessary to scope other areas with fall outside of the current aerial imagery.

This survey was carried out alongside Devon & Severn IFCA and the next review period will be scheduled for 2024. Future survey data will be requested in the same projection as the 2020 layers (EPSG: 3857).

## 6 References

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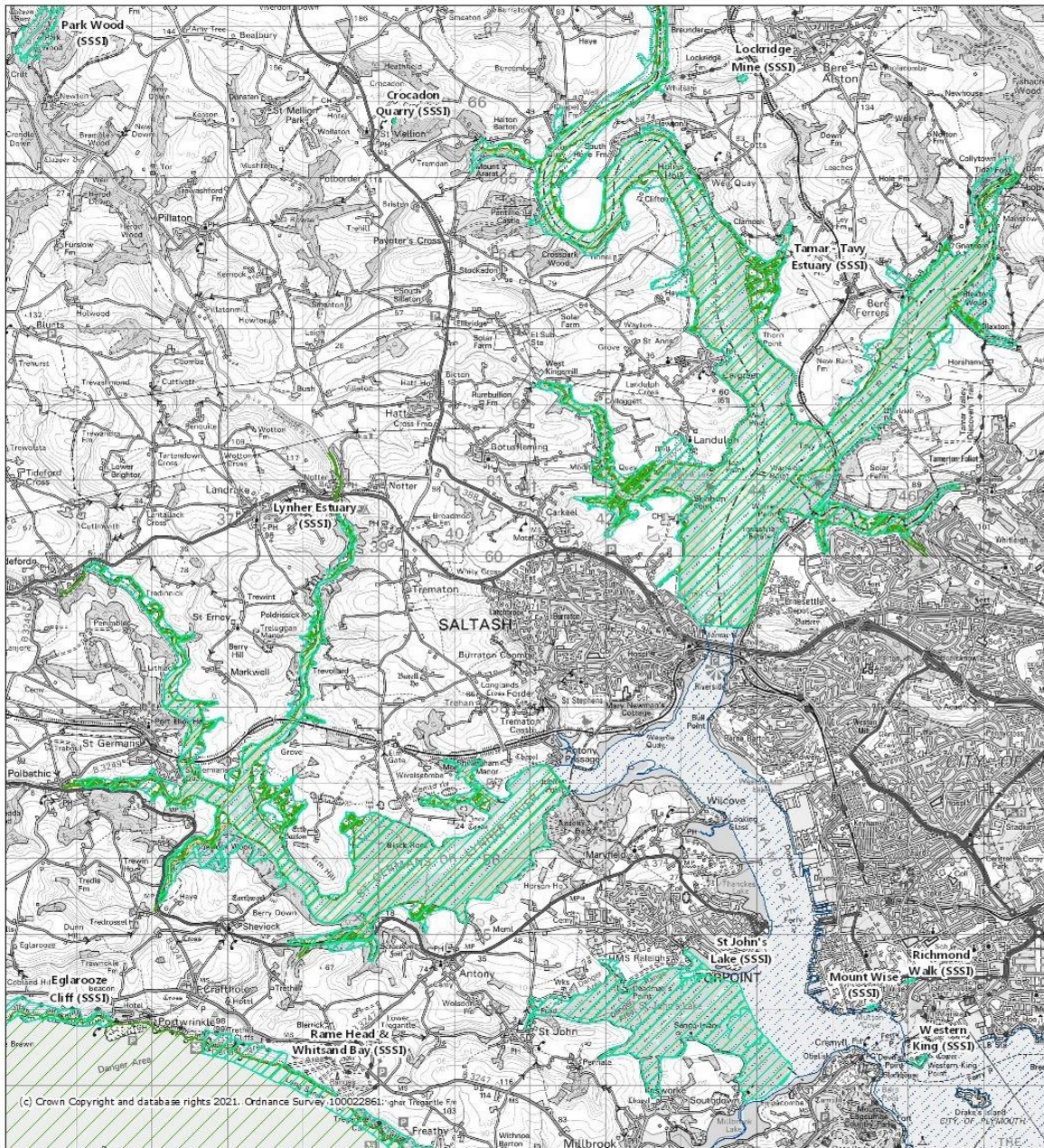
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**MAGiC Tamar Estuary Designations**



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<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="color: green;">■</span> Sites of Special Scientific Interest (England)</li> <li><b>Marine Conservation Zones (England)</b></li> <li><span style="color: green;">■</span> Designated</li> <li><b>Special Areas of Conservation (Marine Components GB)</b></li> <li><span style="border: 1px dashed gray; display: inline-block; width: 10px; height: 10px;"></span> Candidate</li> <li><span style="border: 1px solid gray; display: inline-block; width: 10px; height: 10px;"></span> Designated</li> <li><span style="border: 1px dotted gray; display: inline-block; width: 10px; height: 10px;"></span> Possible</li> <li><b>Special Protection Areas (Marine Components GB)</b></li> <li><span style="border: 1px solid gray; display: inline-block; width: 10px; height: 10px;"></span> Classified</li> <li><span style="border: 1px dashed gray; display: inline-block; width: 10px; height: 10px;"></span> Potential</li> </ul>	<p>0 1.5 3 km</p> <p>Projection = OSGB36                  xmin = 228400                  ymin = 53310                  xmax = 253600                  ymax = 66130</p> <p>Map produced by MAGiC on 15 June, 2021.                  Copyright resides with the data suppliers and the map must not be reproduced without their permission.                  Some information in MAGiC is a snapshot of the information that is being maintained or continually updated by the originating organisation. Please refer to the metadata for details as information may be illustrative or representative rather than definitive at this stage.</p>
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Annex Figure A: Tamar Estuary Sites Marine Conservation Zone (MCZ), Plymouth Sound and Estuaries Special Area of Conservation (SAC), Tamar Estuaries Complex Special Protection Area (SPA) and Sites of Special Scientific Interest (SSSI) within the Tamar Estuary. (MagicMap, 2021).

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## Annex 2 - Vertical Horizons Media Aerial Surveying Technical Specification

### Survey vehicle:

- Airframe- Based on DJI Phantom 2.
- Avionics –Naza M, IOSD, 2.5G ground station, Flytrex core2 GPS logger
- Sensors – GPS location, GPS altitude, barometric pressure altitude, Magnetic compass
- Autopilot- Fully autonomous, max 16 waypoints.
- Imaging – H3-3D 3 axis gimbal, gopro 3+ with 12mm rectilinear optics.

### Operator details:

- Operator – Duncan Hine T/A Vertical Horizons media
- Insurance - £5 million public liability underwritten by Lloyds.
- License – Permitted by the CAA to conduct aerial works.

### Survey parameters:

- Target Ground Spacing Distance (GSD) – 1pixel/cm
- Airspeed – 6 m/s
- Survey altitude – 20m AGL
- Approx. area covered by each image to obtain a GSD of 1@20m AGL – 40x30m
- Target frontal overlap – 80%
- Target lateral overlap- 74%
- Approximate track spacing – 25m
- Track generation – Manual to allow operator to compensate for obstacles and wind drift.

### Post processing software:

- GPSBable – Convert raw GPS log data to GPX format
- Geosetter – Insert GPS track data from GPX into image EXIF data
- Pix4D – Image stitching and geo-tile creation.