Wrasse Tagging Falmouth Bay Survey Report 2019

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

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Glossary of terms

Exposed: 'At these sites, prevailing wind is onshore although there is a degree of shelter because of extensive shallow areas offshore, offshore obstructions, a restricted (<90°) window to open water. These sites will not generally be exposed to strong or regular swell. This can also include open coasts facing away from prevailing winds but where string winds with a long fetch are frequent' (Hiscock, 1996).

Moderately exposed: 'These sites generally include open coasts facing away from prevailing winds and without a long fetch but where strong winds can be frequent' (Hiscock, 1996).

Nights Lie: The numbers of nights since the traps were baited.

Sheltered: 'At these sites, there is a restricted fetch and/or open water window. Coasts can face prevailing winds but with a short fetch (say <20km) or extensive shallow areas offshore or may face away from prevailing winds' (Hiscock, 1996).

String(s): A collection of traps, set together on one back rope.

Trap(s): The individual fish traps used for catching wrasse.

(Wrasse) Tagged: All ballan, goldsinny, corkwing and rock cook that were retained in traps were tagged using coloured tags which are injected beneath clear or translucent tissue and externally visible.

(Wrasse) Recaptured: All ballan, goldsinny, corkwing and rock cook that were previously tagged and that were retained in traps again.

1 Project background

Wrasse have been found to be particularly effective as cleaner fish and have been used as part of many salmon production company's sea lice control strategies along with more traditional chemical treatments. Although having been practiced in Scotland and off the Norwegian coast for nearly 30 years, fishing for and retaining of live wrasse to supply the salmon production industry with cleaner fish is an extremely new and innovative fishery to the south west of England. Concerns for the long term effectiveness of current chemical treatments and the impact of those chemicals to the wider marine environment has seen measures introduced to restrict their use. Additionally, the industry has recognised the economic benefits of using cleaner fish rather than a dependence on chemical controls. The restrictions applied to the use of chemical treatments and increased use of cleaner fish has seen production companies sourcing wrasse from further afield than Scotland to maintain supply without exhausting local stocks (L Bennett, R Hawkins, 2017, pers. comm.). In Cornwall, fishing for wrasse using traps began as very small scale experimental fishing during 2014. Those initial trials have led to the fishers who carried out those early experiments now almost wholly relying on the fishery for their income. There are five known species of wrasse in Cornwall IFCA district; ballan (*Labrus bergylta*), corkwing (*Symphodus melops*), rock cook (*Centrolabrus exoletus*), goldsinny (*Ctenolabrus rupestris*) and cuckoo (*Labrus mixtus*). Cuckoo wrasse are not targeted by the fishery. Ballan, corkwing, rock cook and goldsinny are targeted out of Plymouth and only ballan wrasse are targeted near Falmouth and Mevagissey.

Cornwall Inshore Fisheries and Conservation Authority (IFCA) Scientific Officers have carried out independent sampling effort onboard their own survey vessel, Tiger Lily VI, in 2016 (Street *et al.* 2016) and 2017 (Street *et al.* 2017a), alongside carrying out fishery dependent sampling onboard the commercial wrasse fishing vessels (Street *et al.* 2017b; Sturgeon *et al.,* 2018a). This sampling has gathered data on catch per unit effort (CPUE), fishery spatial distribution, species composition, length frequency, spawning state, size at maturity and sex ratios of wrasse within the Cornwall IFCA district. This data has resulted in a greater understanding of wrasse habitat preferences locally and baseline data on wrasse populations retained in traps. There is still, however, limited information on wrasse stocks within the Cornwall IFCA district and because of this Cornwall IFCA have introduced the Live Wrasse Fishing (Limited Permit) Byelaw[1] to manage and monitor the fishery. Street *et al.* (2017b) recommended for future Cornwall IFCA surveys a mark and recapture study could be undertaken in order to estimate population sizes locally.

With the help of Natural England, Cornwall IFCA received funding from the DEFRA Science Capital Bid to purchase survey equipment including; fish traps (and associated rigging e.g. ropes, buoys) and Visible Implant Elastomer (VIE) Tagging equipment (Northwest Marine Technology Inc.). VIE tags are coloured tags which are injected as liquid,

[1] The Live Wrasse Fishing (Limited Permit) Byelaw came into force on 4th February 2019 https://secure.toolkitfiles.co.uk/clients/17099/sitedata/Byelaws%20and%20orders/Cornwall_IFCA/Live-Wrasse-Fishing-Byelaw-2018.pdf

implanted beneath clear or translucent tissue, which then cures into a pliable solid. The VIE tags remain externally visible and when using fluorescent colours, they can be highly visible under a deep violet light.

A pilot survey was carried out in Veryan Bay in order to determine VIE tagging methodology and the effectiveness of using VIE tags to carry out a mark and re-capture survey (Sturgeon *et al.,* 2018b). A further wrasse tagging survey was carried out in Falmouth Bay in 2018 (Sturgeon *et al.,* 2018c) however, due to unforeseen circumstances the recapture survey could not be carried out in full. This report summarises a continuation of the wrasse tagging survey in Falmouth Bay which provides baseline data of wrasse population estimates in a previously fished area for future monitoring.

1.1 Aims and Objectives

The aims of the study were to use VIE tags on wrasse for a mark and re-capture survey within Falmouth Bay.

1.1.1 Aims

- To carry out a mark and re-capture survey of commercially important wrasse species within previously fished areas of Falmouth Bay using VIE tags to act as a baseline for future monitoring.

1.1.2 Objectives

- Set and haul nine strings of 10 traps within Falmouth Bay from research vessel (R/V) Tiger Lily VI.
- Compare catch data from two separate hauls at each string and between the three separate locations.
- Assess the number of tagged wrasse recaptured.

2 Methodology

2.1 Survey equipment set up

2.1.1 Size of traps

The local fishers use wrasse traps supplied by the salmon farms. The traps (Figure 1) are manufactured by Carapax[2], measure 72 cm length x 40 cm width x 28 cm height, weigh 3.7 kg and are composed of small mesh netting with a self-closable parlour entrance. A live wrasse fishery permit holder allowed Cornwall IFCA to use their gear while it was at sea but not in use. The traps were already rigged with a back rope and end markers.

Figure 1: Carapax wrasse trap used for survey (source: carapax.se).

2.1.2 Weight of traps

The traps used had a frame around the base of the trap to add weight and protect the base (Figure 2). In the wrasse fishery, modifications have been made that appear to increase the efficieny and longevity of the traps.

Figure 2: Example of modifications that have been made to wrasse traps.

2.1.3 Condition of the traps

The traps used had not been cleaned during the season and had built up a layer of algae (Figure 3).

[2] http://en.carapax.se/creelspotstraps/cleaning-wrasse-traps/wrasse-trap.html

Figure 3: An example of the algae growth covering the wrasse traps.

2.1.4 Escape gaps

The traps had escape gaps fitted (Figure 4) which each measure 7 cm in height and 1 cm in width.

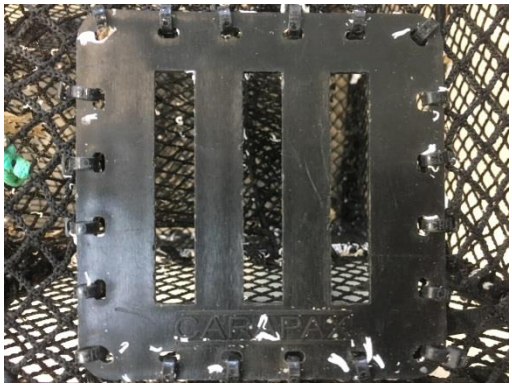

Figure 4: An example of the escape gaps on each wrasse trap.

2.1.5 Distance between traps

Local fishers have a 10 fathom (18.3 m) backrope between traps.

2.1.6 Weighted ends

The strings were rigged with one parlor pot at each end as shown in Figure 5.

Figure 5: Parlour pots attached to either end of the string of wrasse traps, used as weight ends.

2.1.7 Number of traps per string

The strings were set with 10 traps per string and nine strings were used in the survey. However, one string had 11 traps.

1.1.1 Nights lie

The nine strings were set on 5th August and hauled on 7th August for tagging. The same strings were set for recapture on 19th August and hauled on 21st August. Both the tagging set and the recapture set were for two nights.

2.2 Methodology for setting and hauling traps

The survey was carried out from Cornwall IFCA research vessel (R/V) Tiger Lily VI (Figure 6), which is a South Boats 11 m Island MkII catamaran with twin IVECO 450hp engines (Annex 1).

Figure 6: Research Vessel (R/V) Tiger Lily VI – Cornwall IFCA's research survey vessel.

2.2.1 Shooting

The traps were first shot from a commercial fishing vessel and were baited using cooked crab shell (approximately two handfuls per trap). The traps were shot into the tide, with the back rope kept tight so that the traps were evenly spaced. Once at the starting position for a string the first marker was deployed over the side. The skipper slowly navigated the boat to the desired end point of the string whilst the deck crew deployed the traps; as the back rope became tight the first trap was deployed, then the process was repeated with each trap until the entire string was in the water. A mark was made on a handheld Garmin GPS 60™ when each parlour pot and trap left the stern of the fishing vessel. When shooting from RV Tiger Lily, a target was made on HYPACK®MAX (Version 2018) when each parlour pot and trap was deployed over the side and was labelled with the trap and string number. A clear line of sight and communication was maintained between skipper and deck crew throughout the shooting operation.

2.2.2 Hauling

The traps were hauled into the tide so that the vessel didn't run over the back line as it was being hauled. The traps were hauled slowly to try to prevent swim bladder damage so as to limit damage to the wrasse. As each trap was brought aboard the contents of each trap were emptied into a fish box (Figure 7) and a photograph was taken using an Olympus TG-5 camera. The state of the trap, including if there were any holes, was noted. The species, size and

sex of the individual wrasse was recorded and a note was made if they were spawning. To check if the wrasse were spawning they were 'stripped' by running two fingers with a small amount of pressure along the underside of the wrasse and noting if eggs (female) or milt (male) were expelled. Once measured, the wrasse were transferred to a bucket full of seawater (Figure 7) before being tagged. The remaining contents of the fish box were emptied over the side of the vessel. The trap was then safely stacked on deck. This process was repeated for each trap in the string.

Figure 7: Wrasse being measured from the fish box and then into a bucket with fresh seawater.

2.2.3 VIE Tagging

The unmixed VIE was stored in the fridge onboard the vessel when not in use. Before each string was hauled, the selected coloured elastomer and curing agent were mixed in a 10:1 ratio according to Northwest Marine Technology Inc. instructions[3] (NWM, 2017). Officers used 0.25 ml of elastomer and 0.025 ml of the curing agent which would equate to approximately 50-125 tags and 25-62.5 wrasse (two tags per wrasse) once mixed. The elastomer and curing agent were mixed in a 1 ml transfer syringe using a toothpick for one minute. Approximately 0.1 ml of the mixed VIE was filled into a 0.3 ml injection syringe. Care was taken to ensure no air pockets had formed within the syringes. The injection syringe containing the mixed VIE was stored in the freezer compartment of the fridge until needed to maximise shelf life. To verify the elastomer had cured properly, the mixing cups and transfer syringes were kept in a sealed container for over 24 hours and checked to see if they had set.

Pick and pluck foam was fitted into a plastic box and filled with seawater. Each wrasse that had been measured was placed upside down into a slot in the foam to stabilise the wrasse (Figure 8) and ensure that the sampling officer could keep their non-injecting hand away from the needle. Using the Manual Elastomer Injector, pressure was exerted until the coloured VIE was seen on the tip of the needle. Excess VIE was cleared using paper towel. The needle was inserted under the skin in front of the pectoral fins and VIE was injected as the needle was pulled back. Dispensing of the VIE was stopped before the needle was completely withdrawn. This was to ensure that there was no trailing material to stop the wound from healing or increase tag loss. The two VIE tags were placed parallel,

[3] Available from: https://www.nmt.us/wp-content/uploads/2017/11/10-to-1-Manual-VIE-Kits-Nov-2017.pdf [Accessed: 04/10/2018].

ventrally, directly below the pectoral fins and were approximately 3 mm long depending on the size of the wrasse (Figure 9). This was different from 2018 where the two tags were placed parallel, ventrally, in the centre between the gills and pectoral fins.

Figure 8: Examples of wrasse placed in upside down in foam, whilst inserting VIE tags.

Figure 9: Example of VIE tags in wrasse; green VIE (left), yellow VIE (middle) and red VIE (right).

After tagging, each wrasse was placed carefully into a bin full of fresh seawater to recover. Two bins were used to split the wrasse into those caught in traps one to five and those caught in traps six to ten (Figure 10). This was so the wrasse could be separated from which traps they were caught in and returned as close to where they were caught as was practically possible.

Figure 10: Bins of fresh seawater to acclimatise tagged wrasse before returned back to sea which were split into wrasse from traps 1-5 and 6-10.

At the end of each string, the wrasse were returned to the sea. This was done by first returning those caught in traps one to five by positioning the vessel as centrally as possible to the set of five traps where they were caught using the targets marked on HYPACK. Wrasse were transferred to a smaller bucket using a hand net and once the

vessel was in position the bucket was slowly tipped under the water from the stern of the vessel. Officers ensured all the wrasse had swum down before the vessel moved. This was repeated for the wrasse caught in traps six to ten.

Figure 11: Wrasse being returned back to sea which were split into wrasse from traps 1-5 and 6-10.

For the second day of hauling, the method from section 2.2.2 was repeated. But instead of tagging the wrasse after measuring, wrasse were screened for the presence of VIE tags. This was carried out by holding the wrasse in a shaded area. Using a Visible Implant (VI) Light torch (supplied by Northwest Marine Technology Inc.) with a deep violet wavelength of 405 nm, the area in front of the pectoral finswas lit to show signs of VIE tags (Figure 12). The VI torch causes the VIE tags to fluoresce.. Officers also looked in ambient light in case the glare of the VI Light torch obscured the VIE tags. The VIE Colour Standard (supplied by Northwest Marine Technology Inc.) was kept in close proximity in order to compare the colour sample directly beside a VIE tag for comparison.

Figure 12: Wrasse being screened for VIE tags using the VI Light torch

2.3 Ethics

For animal welfare the three R's (Replace, Reduce and Refine) were considered during the initial survey planning (Russell and Burch 1959; ASPA 1986). During previous surveys Cornwall IFCA officers have been able to refine the sampling procedure in order to minimise stress to all species caught (Street *et al.* 2016, 2017a & 2017b). This includes the handling and release of all species (including by-catch) promptly and with minimal injury. Handling was kept to a minimum and gloves were worn to reduce unnecessary loss of external mucus or scales. Holding buckets and bins were replenished with fresh seawater and monitored to allow wrasse to recover before returning to sea. By-catch was photographed and returned immediately.

Ethical considerations were made for intrusive sampling (VIE tagging) on the welfare of wrasse. Prior to carrying out the survey, Cornwall IFCA officers experimented on dead fish (two mackerel and one ballan wrasse) to become familiar with the tagging procedure and determine suitable tagging locations, as well as consulting with previous work carried out (Skiftesvik *et al.,* 2013). Additionally, a pilot tagging study was carried out to evaluate suitable VIE tag locations, retention rates and tag visibility on wrasse (Sturgeon *et al.,* 2018b). The size and location of the VIE tags used in wrasse were deemed to be appropriate for the size of wrasse. It was also thought desirable that the size and type of tag used should not affect wrasse social interactions or reduce predator avoidance capability. During the survey, cuckoo wrasse were excluded from tagging as this species is not targeted by the wrasse fishery and therefore deemed to be not relevant to meet the aims of the survey. By carrying out the tagging in August, this avoided the main spawning period (May to July, (Street *et al.,* 2017b)) and would reduce tagging vulnerable breeding wrasse. It was also decided before carrying out the survey that any wrasse which were 7 cm and below were deemed too small to be tagged. Additionally, escape gaps in the traps allowed smaller individuals to escape.

Before tagging, the wrasse were visually inspected for any signs of damage to ensure tagging would not hinder the wrasse's health further. For each wrasse the total handling and tagging procedure took less than 30 seconds. During the tagging procedure, wrasse remained still and docile when on their underside, being immersed in water and eyes covered. All wrasse which were caught (excluding cuckoo and individuals less than or equal to 7 cm total length) were tagged as this was deemed an appropriate amount in order to obtain a large enough sample size for a mark and recapture study and achieve the objectives of the survey.

The use of VIE tags in wrasse was deemed to have no lasting harm to wrasse or not to be harmful to humans from introduction into the food chain. The VIE tags are non-toxic and information on the ingestion of VIE tags can be seen in Annex 2. Additionally, the wrasse were not anesthetised as it was deemed unnecessary and it was not possible to ensure that the anaesthetised wrasse, once released, would not end up for human consumption.

Before undertaking the survey, Cornwall IFCA researched relevant legislation and regulations to this survey methodology and sought advice from the University of Exeter. It was decided that VIE tagging carried out to the planned method was not considered to be a regulated procedure under the Animals (Scientific Procedures) Act 1986 Section 2 (8) (e).

2.4 Temporal variables

There are a number of temporal variables which were judged to have a potential impact on the results of this survey. To limit the impact of the tide, wind speed and wind direction the following mitigation measures were followed;

2.4.1 Tidal range

It has been reported that tidal range has an influence over catch rates and Street *et al.* (2017b) found catch rates were highest for the period of time after a peak spring tide. The tidal height range was 4.39 m to 4.59 m (taken from the closest port, Falmouth) for the duration of the survey.

2.4.2 Wind speed

The survey would only take place in wind speeds of less than 30 mph for the entire time that the traps are fishing.

2.4.3 Wind direction

All survey locations were to be on the south coast with a southerly or easterly aspect. No survey would take place in an easterly wind with a NE-S wind above 10 mph. This was for vessel safety when working so close in to shore and to reduce the influence of wind on the survey.

2.5 Location of strings

Three previously fished locations within Falmouth Bay were chosen as the focus of the survey (Figure 13) and these were repeats of areas chosen in 2018 (Sturgeon *et al.,* 2018c). St Anthony Head was chosen as exposed reef habitat, Mawnan to August Rock and Rosemullion Head were selected as moderately exposed reef habitat. Due to time constraints the sheltered seagrass beds in St Mawes, Trefusis and Helford were not able to be surveyed this year. Three strings were set per location.

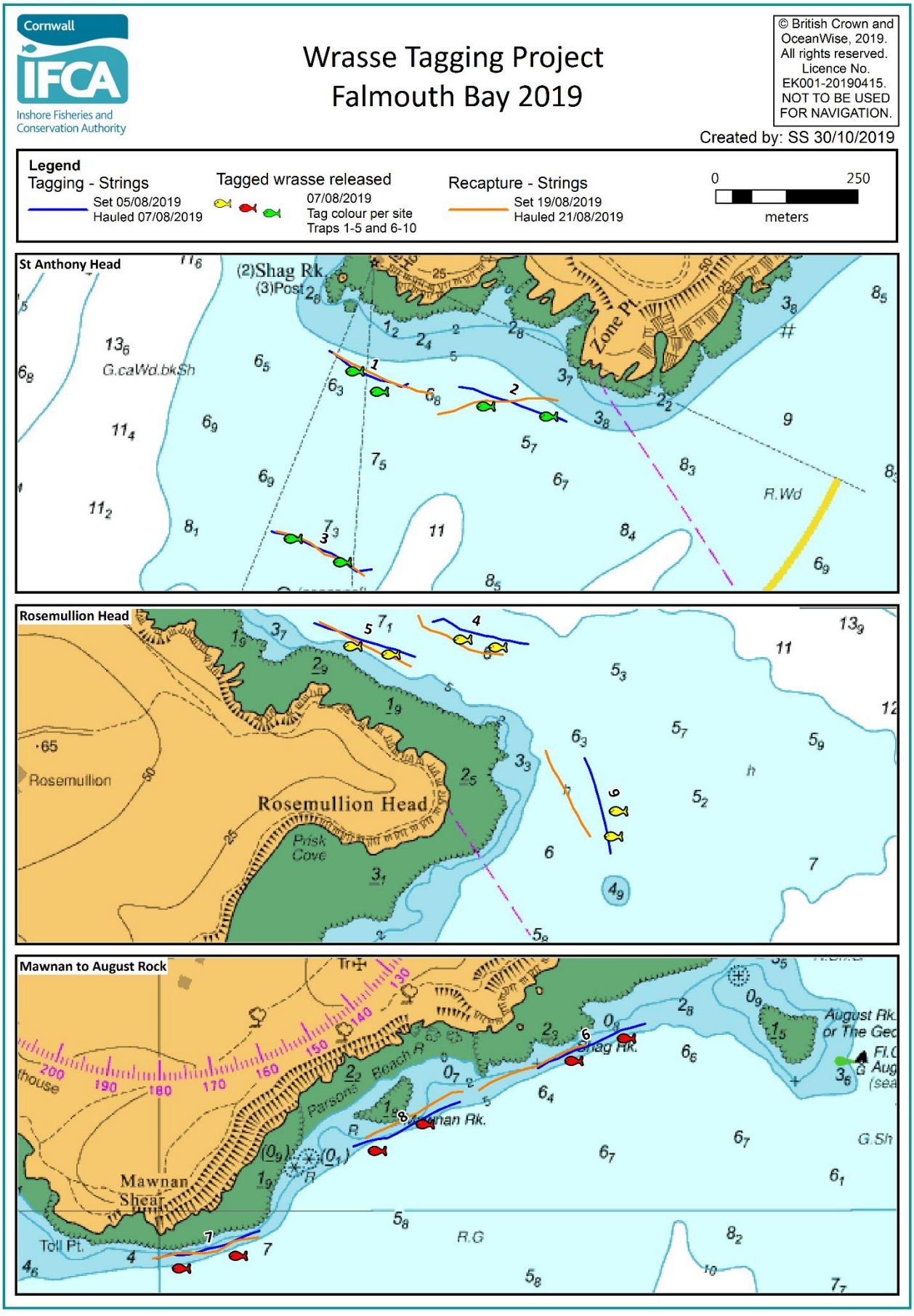

Figure 13: Location of strings sampled for tagging and recapture in Falmouth Bay during August 2019.

2.6 Data recording

When each trap was shot overboard a GPS waypoint or HYPACK target for their position was created, enabling them to be accurately located and the whole string replicated for the following recapture. Images taken on the camera were copied and transferred into organised files. By-catch was recorded by analysing each image of trap contents. When recording catch details, the species, length, sex, spawning or not spawning, damage to the wrasse and swim bladder damage was documented on waterproof paper. As well as tag colour, number of tags and tag location and any other relevant information e.g. hole in trap. All catch details were then transferred into a Microsoft Excel workbook for analysis.

Waypoints and track data from the handheld GPS were exported using Garmin MapSource (Version 6.13.7). The targets were exported from HYPACK as a .txt file and opened in Excel. Once reviewed, the Excel file was then transferred to the GI software, MapInfo Profession (Version 17.0.2) where data points were created to give a visualisation of the location of each string.

The daily logs for all survey days are shown in Annex 4.

2.7 Statistical Analysis

Analysis of total length (cm) and population size estimates were carried out in R Version 3.6.1 (R Core Team, 2019) with package FSA (Ogle, Wheeler and Dinno, 2019).

To estimate population size for wrasse within the three survey sites, the Petersen model was used. This is based on a closed population for two visits. Where $\widehat{N}$ is estimated population size, *C* catch taken, *M* marked individuals, and *R* marked individuals recaptured.

$$\widehat{N} = \frac{C \times M}{R}$$

For where small sample sizes ($R \geq 7$) were found and where the numbers of recaptures were zero, the Chapman modification (Chapman, 1951) was used.

$$\widehat{N} = \frac{(M+1)(C+1)}{R+1} - 1$$

The upper and lower 95% confidence intervals were calculated in R. The binomial approximation was used if the fraction of tagged fish in the second sample was 'large' (i.e. $\frac{R}{C}$ greater than 0.1). If not, the poisson confidence intervals were used.

During the period between tagging (7th August 2019) and recapture (21st August 2019) fishing activity was observed by sampling onboard the commercial wrasse fishing vessel. For multiple samples the Schnabel method (with Chapman modification) was used. For each sample *t,* the following is determined:

C_t = Total number of individuals caught in sample *t*

R_t = Number of individuals already marked (Recaptures) when caught in sample *t*

M_t = Number of marked animals in the population just before the *t*th sample.

$$\widehat{N} = \frac{\sum M_t C_t}{(\sum R_t) + 1}$$

The upper and lower 95% confidence intervals were calculated in R using the Poisson method.

3 Results

The approximate area for each site can be seen in Table 1. During the tagging survey, a total of 297 wrasse were retained and measured from five different species of wrasse; ballan, cuckoo, goldsinny, corkwing and rock cook. A total of 276 wrasse (excluding cuckoo) were tagged (Table 2 to Table 4). During the recapture survey, 12 wrasse (excluding cuckoo) were found with tags out of a total of 296 wrasse (all species) retained and measured.

Table 1: Combined approximate area of strings for each site, calculated with 10 m buffer.

Site	Area (m²)
St Anthony Head	9,142
Rosemullion Head	9,829
Mawnan to August Rock	10,237

Table 2: Number of ballan, goldsinny, corkwing and rock cook caught, tagged and recaptured at St Anthony Head with the estimated population sizes for wrasse caught in traps.

St Anthony Head					Estimate Population size = N	Upper and Lower Confidence Interval
	7th August 2019		21st August 2019			
Species	Caught	Tagged	Caught	Recaptured		
#Ballan	20	20	6	1	72	32 to 254
#Goldsinny	35	33	36	1	628	190 to 1,226
#Corkwing	17	17	26	1	242	73 to 473
#Rock cook	29	29	34	3	262	107 to 648
Total#	101	99	102	6		

Table 3: Number of ballan, goldsinny, corkwing and rock cook caught, tagged and recaptured at Rosemullion Head with the estimated population sizes for wrasse caught in traps.

Rosemullion Head					Estimate Population size = N	Upper and Lower Confidence Interval
	7th August 2019		21st August 2019			
Species	Caught	Tagged	Caught	Recaptured		
#Ballan	9	9	7	1	39	16 to 139
#Goldsinny	53	48	36	0	1812	386 to 1,812
#Corkwing	19	18	8	1	84	34 to 300
#Rock cook	34	34	25	0	909	193 to 909
Total#	115	110	76	2		

Table 4: Number of ballan, goldsinny, corkwing and rock cook caught, tagged and recaptured at Mawnan to August Rock with the estimated population sizes for wrasse caught in traps.

Mawnan to August Rock					Estimate Population size = N	Upper and Lower Confidence Interval
	7th August 2019		21st August 2019			
Species	Caught	Tagged	Caught	Recaptured		
#Ballan	8	8	11	1	53	15 to 104
#Goldsinny	19	18	13	0	265	56 to 265
#Corkwing	16	16	32	0	560	119 to 560
#Rock cook	26	26	46	3	316	129 to783
Total#	69	68	102	4		

3.1 Catch composition

The number of wrasse species per string for each survey day is shown in Figure 14 and Figure 15.

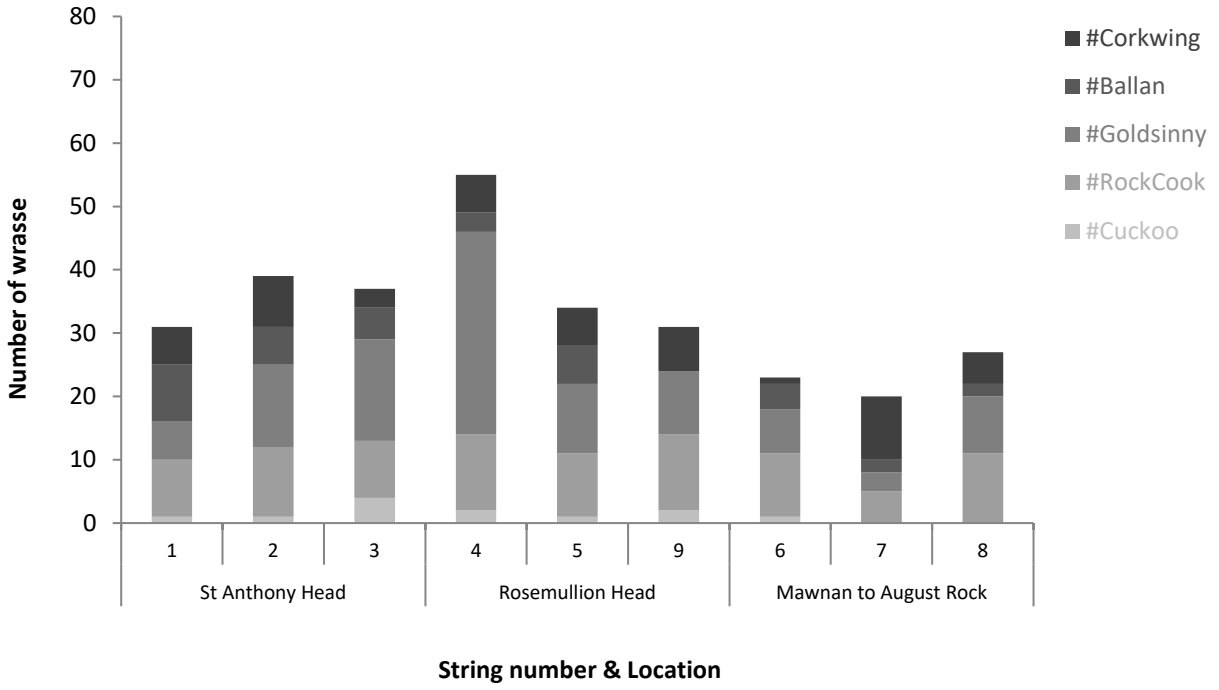

Figure 14: The number of species of wrasse (ballan, corkwing, goldsinny, rock cook and cuckoo) per string from 7th August 2019.

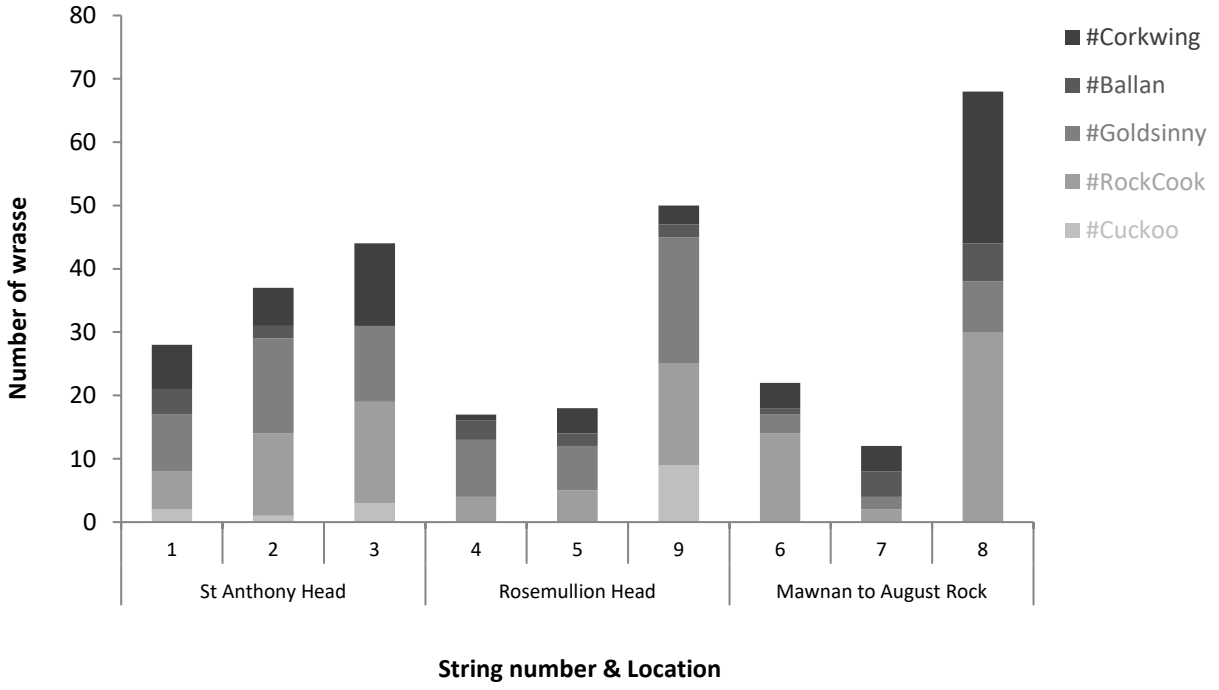

Figure 15: The number of species of wrasse (ballan, corkwing, goldsinny, rock cook and cuckoo) per string from 21st August 2019.

The catch composition of wrasse per location is shown in Figure 16 to Figure 18 for 7th and 21st August 2019.

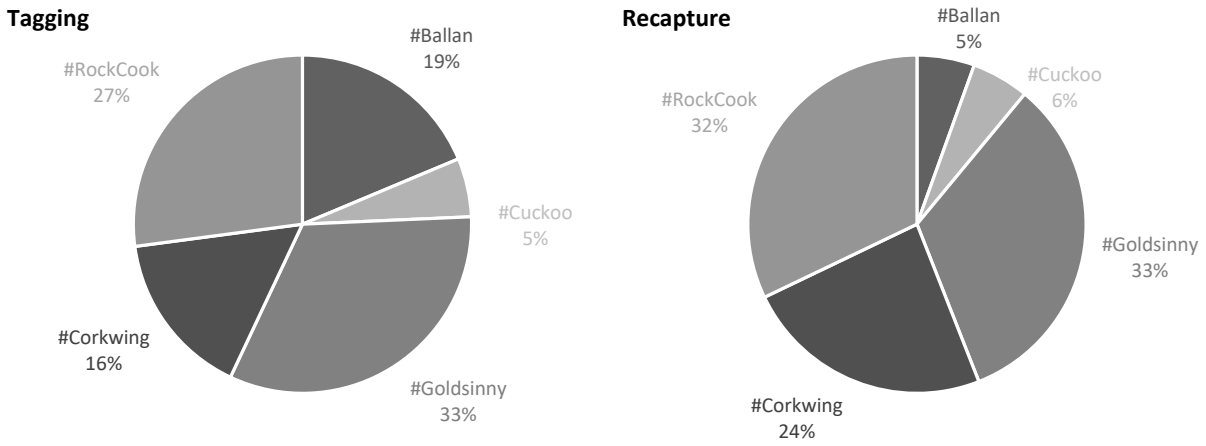

Figure 16: Catch composition of the wrasse species recorded at St Anthony Head on 7th and 21st August 2019.

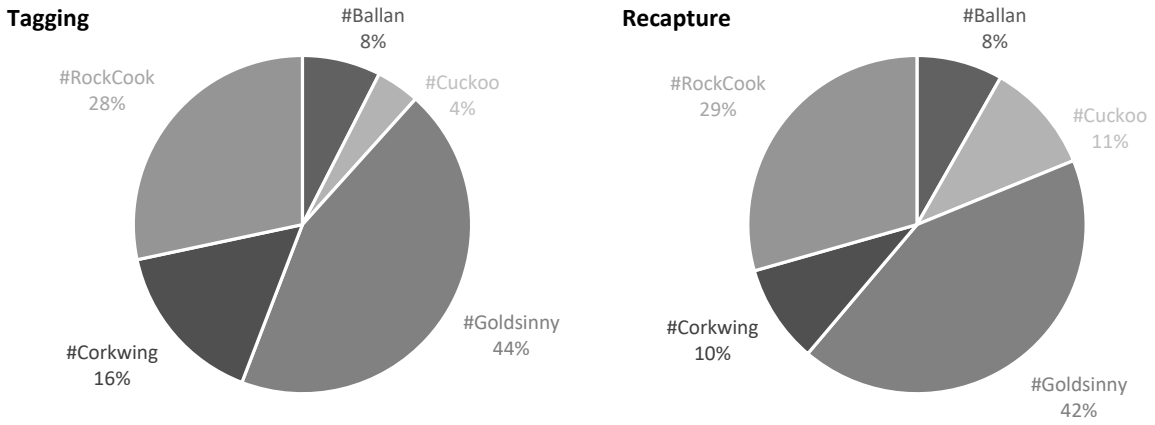

Figure 17: Catch composition of the wrasse species recorded at Rosemullion Head on 7th and 21st August 2019.

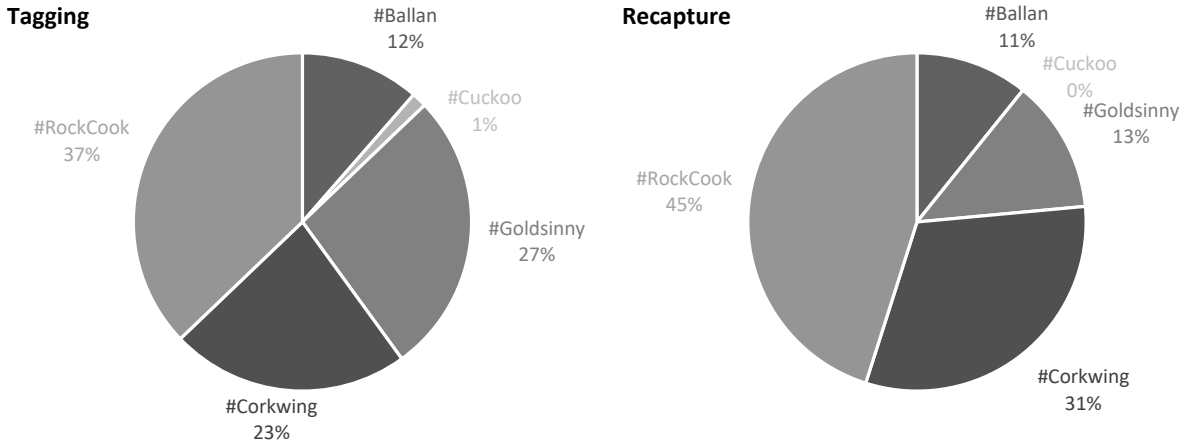

Figure 18: Catch composition of the wrasse species recorded at Mawnan to August Rock on 7th and 21st August 2019.

3.2 Length Frequency

The total length of ballan, goldsinny, corkwing, rock cook and cuckoo wrasse for each site can be seen in Figure 19 to Figure 20.

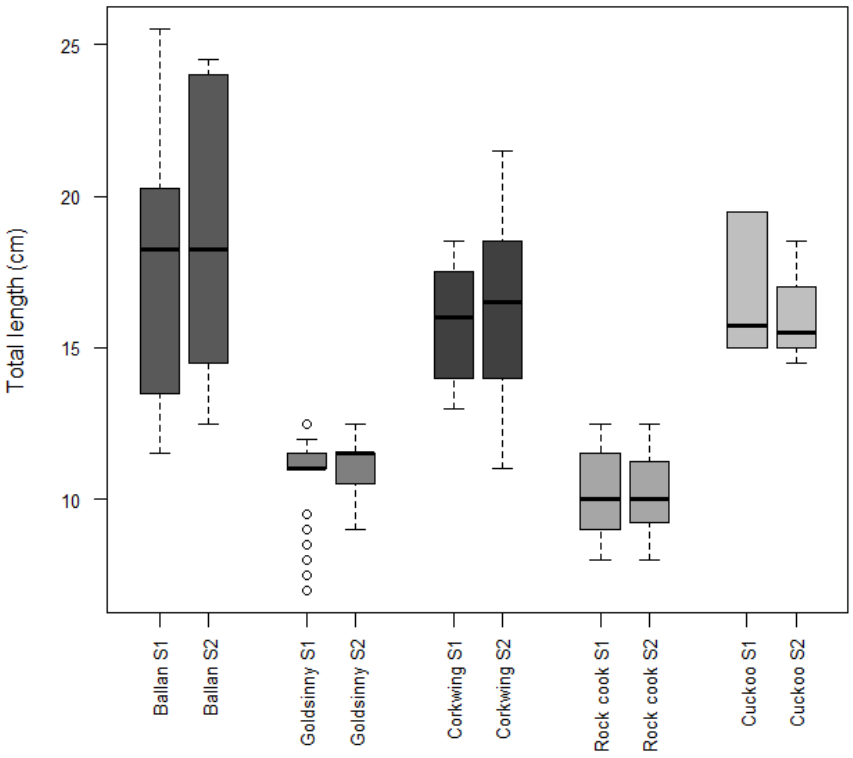

Figure 19: Total length in cm for ballan, goldsinny, corkwing, rock cook and cuckoo wrasse sampled in strings 1-3 at St Anthony Head. Data is grouped by sample number (S1 and S2). Stripes show median, boxes show inter-quartile, error bars show range and hollow circles show outliers.

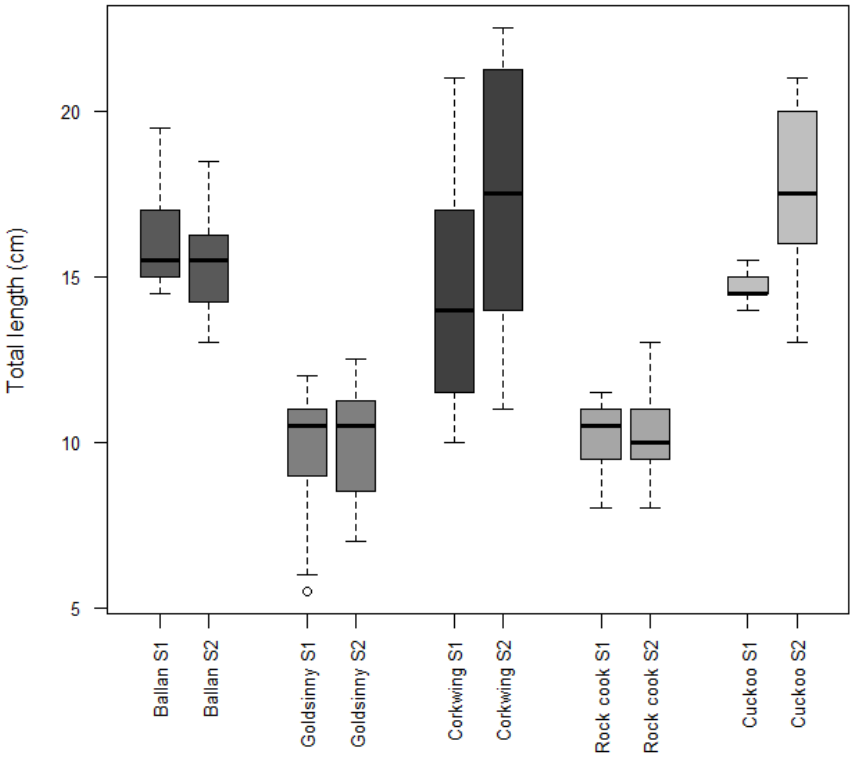

Figure 20: Total length in cm for ballan, goldsinny, corkwing, rock cook and cuckoo wrasse sampled in strings 4, 5 and 9 at Rosemullion Head. Data is grouped by sample number (S1 and S2). Stripes show median, boxes show inter-quartile, error bars show range and hollow circles show outliers.

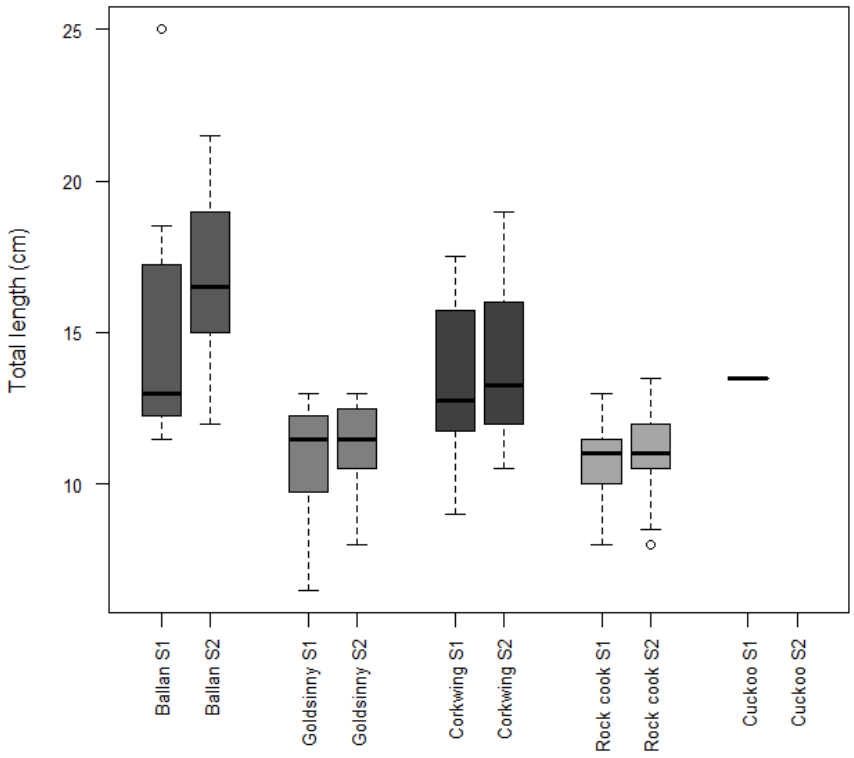

Figure 21: Total length in cm for ballan, goldsinny, corkwing, rock cook and cuckoo wrasse sampled in strings 6-8 at Mawnan to August Rock. Data is grouped by sample number (S1 and S2). Stripes show median, boxes show inter-quartile, error bars show range and hollow circles show outliers.

3.3 By-catch

Each trap was emptied into a fish box once recovered to deck and photographed for later identification. A list of the recorded by-catch can be seen in Table 5 and Table 6.

Table 5: List of by-catch species recorded from all three sites during the wrasse survey on 7th August 2019.

Common name	Species name	St Anthony Head Totals	Rosemullion Head Totals	Mawnan to August Rock Totals	All Sites Totals
Common dragonet	*Callionymus lyra*	0	1	1	**2**
Edible crab	*Cancer pagurus*	5	4	3	**12**
Shore crab	*Carcinus maenas*	0	0	7	**7**
Conger eel	*Conger conger*	3	3	6	**12**
Juvenile Gadidae	Gadidae sp.	0	2	6	**8**
Shore rockling or five bearded rockling	*Gaidropsarus mediterraneus* or *Ciliata mustela*	2	0	1	**3**
Three bearded rockling	*Gaidropsarus vulgaris*	1	0	0	**1**
Squat lobster	*Galathea squamifera*	1	0	1	**2**
Juvenile lobster	*Homarus gammarus*	1	5	4	**10**
Spider crab	Inachus sp.	2	2	0	**4**
Wrinkled swimming crab	*Liocarcinus corrugatus*	1	0	1	**2**
Harbour crab	*Liocarcinus depurator*	1	0	0	**1**
Spiny starfish	*Marthasterias glacialis*	79	24	6	**109**
Velvet swimming crab	*Necora puber*	65	36	43	**144**
Prawn sp.	*Palaemon sp.*	7	1	9	**17**
Tompot Blenny	*Parablennius gattorugine*	26	14	26	**66**
Long-spined sea scorpion	*Taurulus bubalis*	10	2	8	**20**
Netted dog whelk	*Tritia reticulata*	0	6	2	**8**
Cowrie	*Trivia arctica*	0	0	1	**1**
Topknot	*Zeugopterus punctatus*	0	1	0	**1**

Table 6: List of by-catch species recorded during the wrasse surveys on 21st August 2019.

Common name	Species name	St Anthony Head Totals	Rosemullion Head Totals	Mawnan to August Rock Totals	All Sites Totals
Edible crab	*Cancer pagurus*	3	2	1	**6**
Conger eel	*Conger conger*	4	4	3	**11**
Juvenile Gadidae	Gadidae sp.	0	2	4	**6**
Shore rockling or five bearded rockling	*Gaidropsarus mediterraneus* or *Ciliata mustela*	1	0	3	**4**
Three bearded rockling	*Gaidropsarus vulgaris*	0	1	0	**1**
Squat lobster	*Galathea squamifera*	1	2	3	**6**
Rock goby	*Gobius paganellus*	0	0	1	**1**
Juvenile lobster	*Homarus gammarus*	1	1	1	**3**
Great spider crab	*Hyas araneus*	0	1	0	**1**
Wrinkled swimming crab	*Liocarcinus corrugatus*	1	0	2	**3**
Harbour crab	*Liocarcinus depurator*	1	1	1	**3**
Spiny starfish	*Marthasterias glacialis*	104	27	3	**134**
Velvet swimming crab	*Necora puber*	43	29	26	**98**
Prawn sp.	*Palaemon sp.*	14	5	2	**21**
Tompot Blenny	*Parablennius gattorugine*	17	6	15	**38**
Great pipefish	*Syngnathus acus*	0	0	1	**1**
Long-spined sea scorpion	*Taurulus bubalis*	7	4	1	**12**
Montagu's crab	*Xantho hydrophilus*	2	0	0	**2**

3.4 Monitoring of fishing activity

During the period between tagging (7th August 2019) and recapture (21st August 2019) fishing activity was observed by sampling onboard a commercial wrasse fishing vessel (referred to as 'fishery dependent sampling'). This was to monitor if any tagged wrasse were caught and retained (direct fishing mortality). Three fishery dependent sampling surveys were carried out and are labelled a to c for each survey area. Figure 22 to Figure 24 show the location of all the strings sampled at each site.

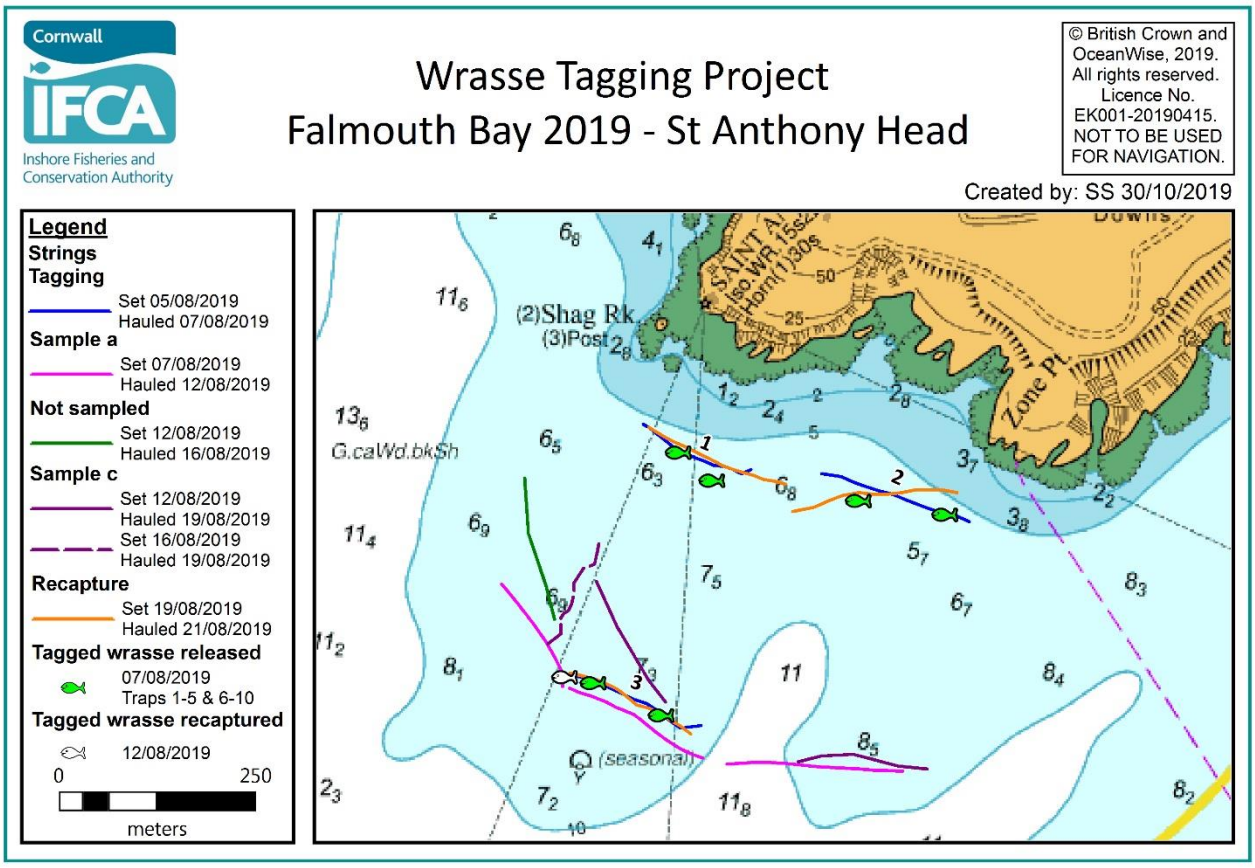

Figure 22: Location of all strings sampled near St Anthony Head in August 2019.

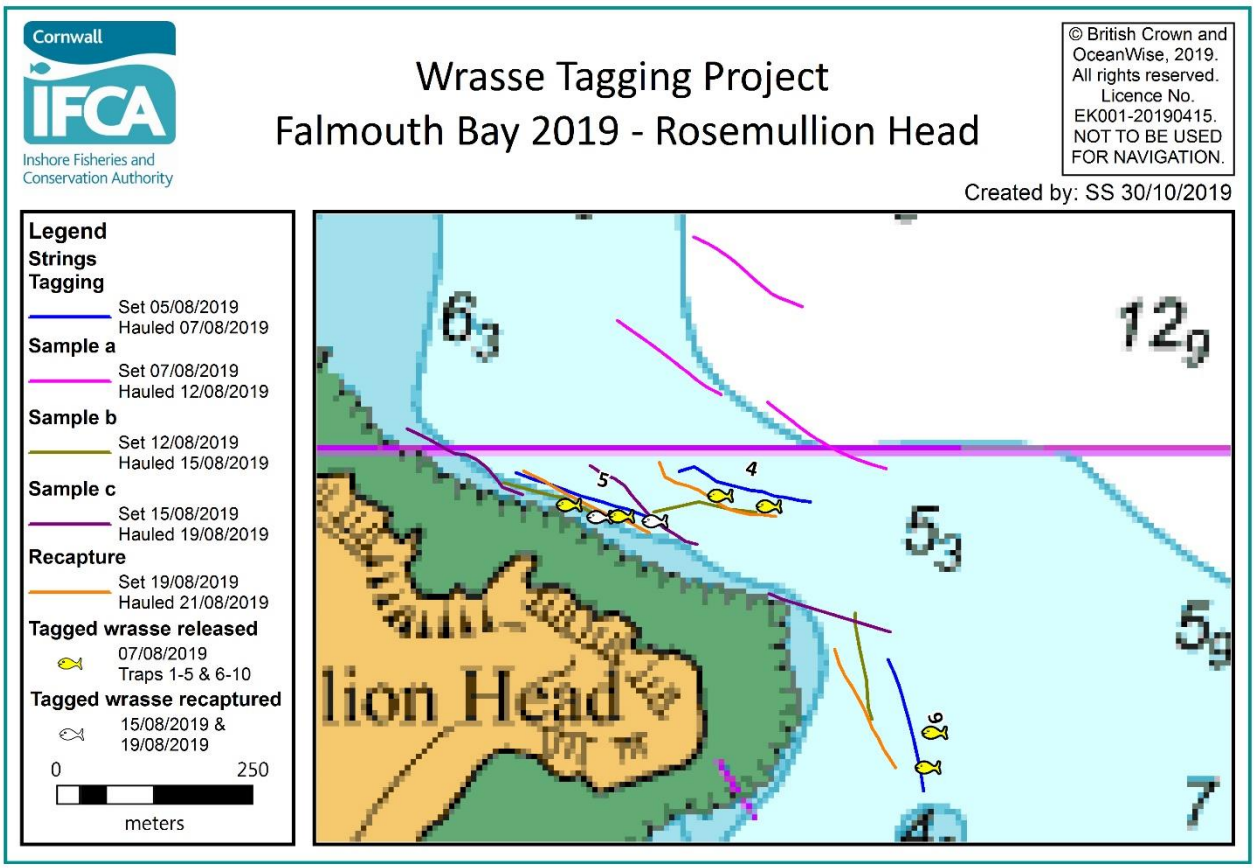

Figure 23: Location of all strings sampled near Rosemullion Head in August 2019.

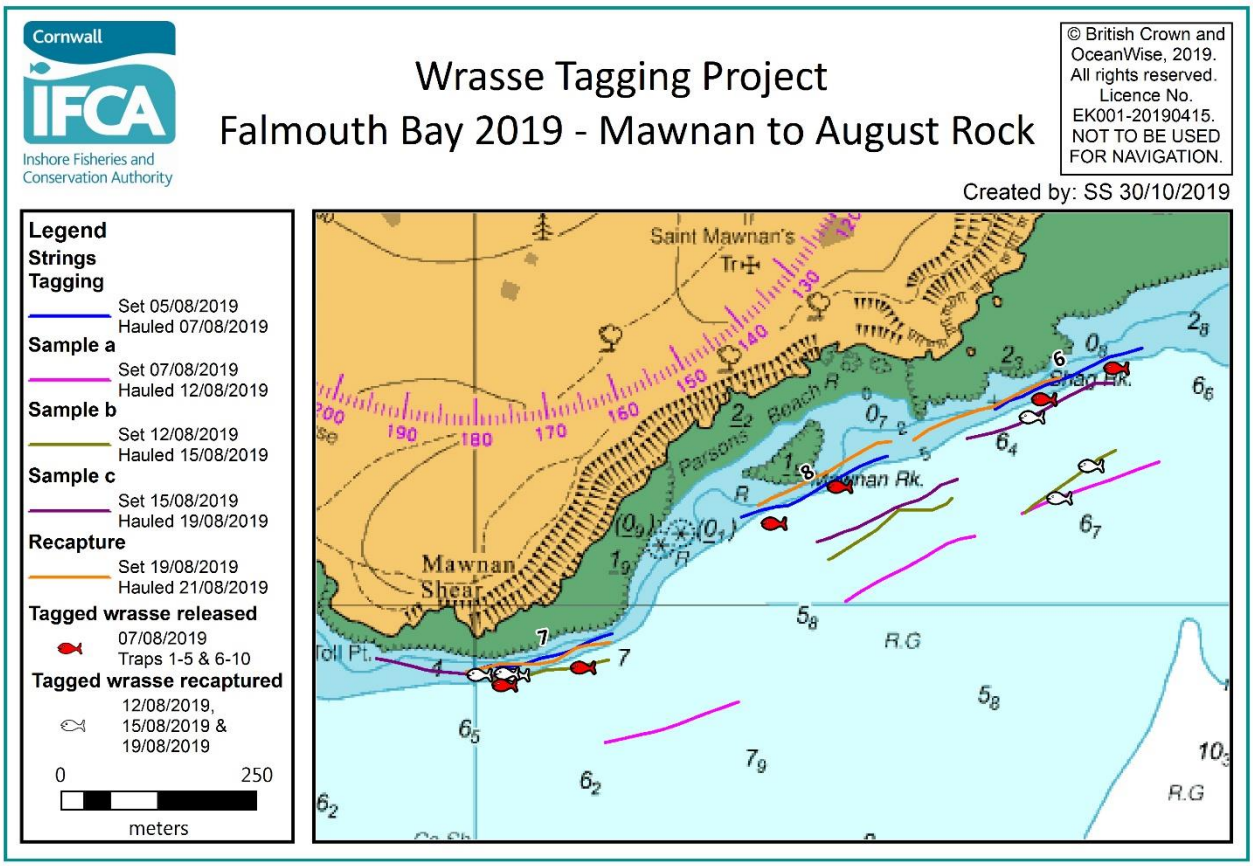

Figure 24: Location of all strings sampled near Mawnan to August Rock in August 2019.

3.4.1 Catch compostion

The number of wrasse species per string for each sampling day is shown in Figure 25 to Figure 27. The labels a, b and c refer to the three fishery dependent sampling surveys and also correspond to the original string numbers (1-9).

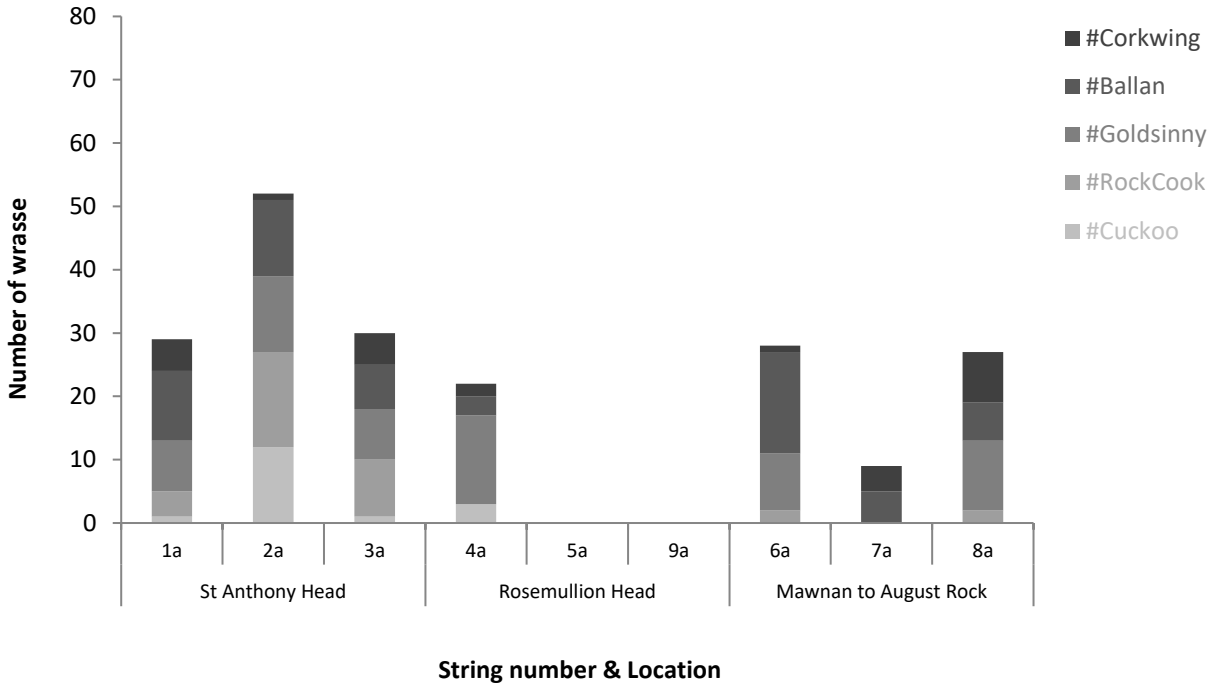

Figure 25: The number of species of wrasse (ballan, corkwing, goldsinny, rock cook and cuckoo) per string from 12th August 2019.

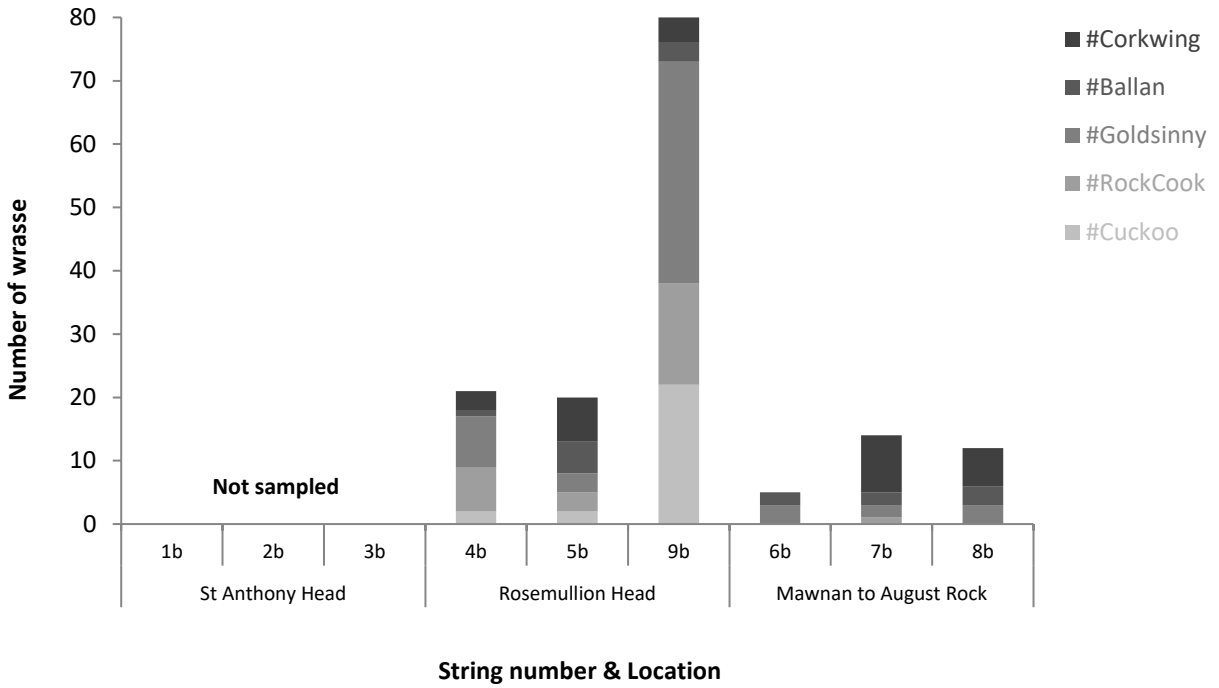

Figure 26: The number of species of wrasse (ballan, corkwing, goldsinny, rock cook and cuckoo) per string from 15th August 2019.

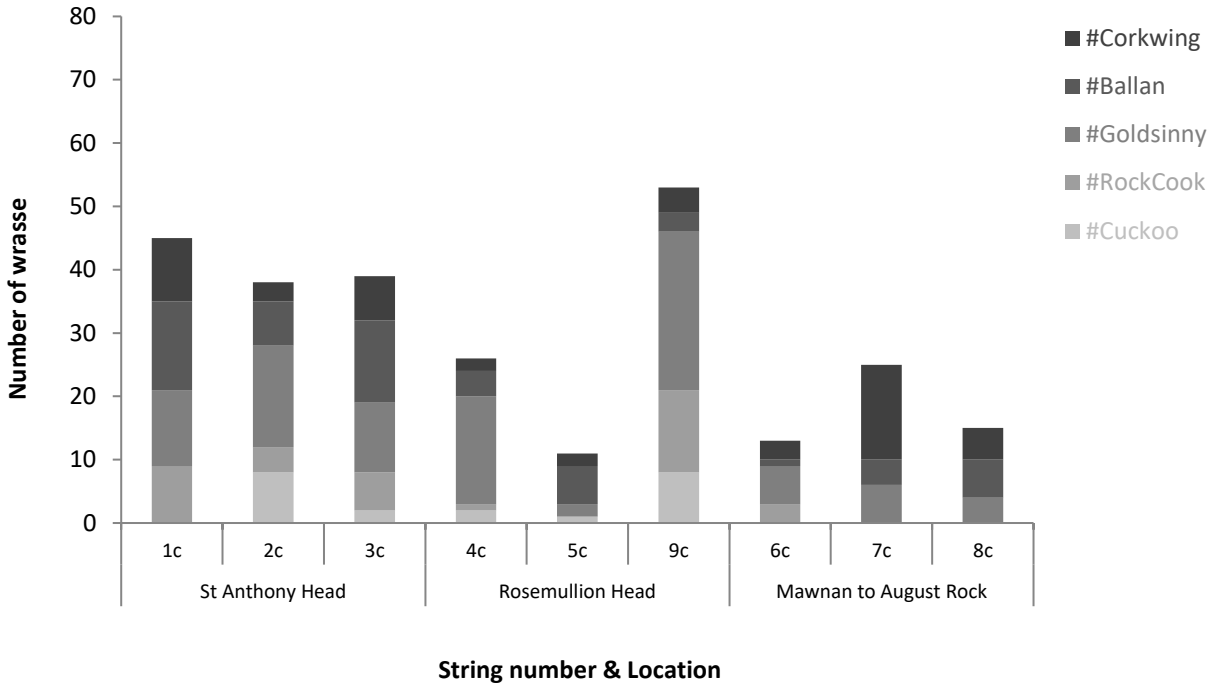

Figure 27: The number of species of wrasse (ballan, corkwing, goldsinny, rock cook and cuckoo) per string from 19th August 2019.

The catch composition of wrasse per location is shown in Figure 28 to Figure 30 for 12th, 15th and 19th August 2019.

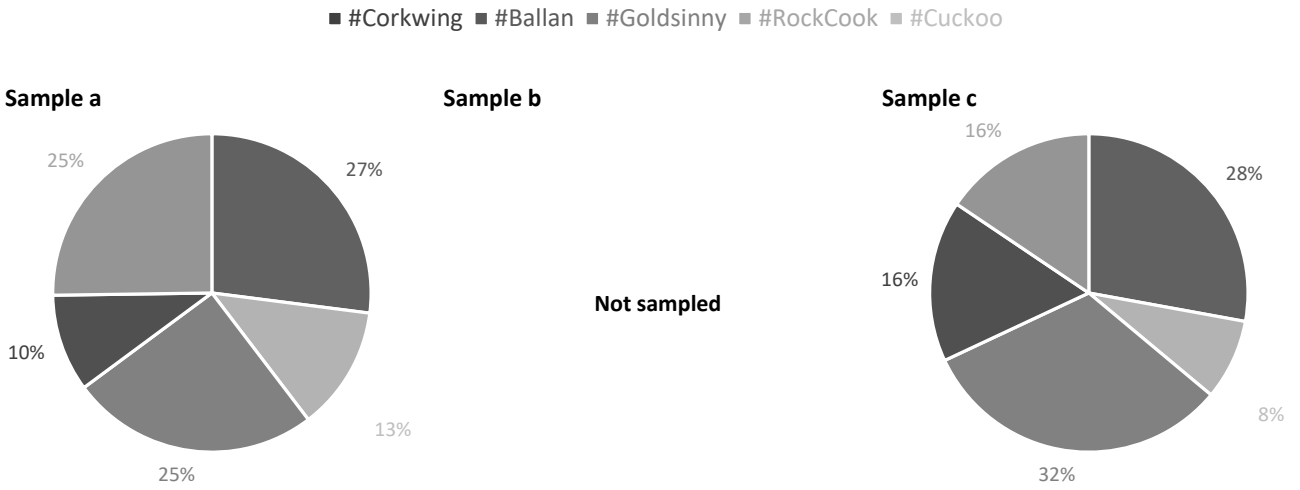

Figure 28: Catch composition of the wrasse species recorded at St Anthony Head on 12th, 15th and 19th August 2019.

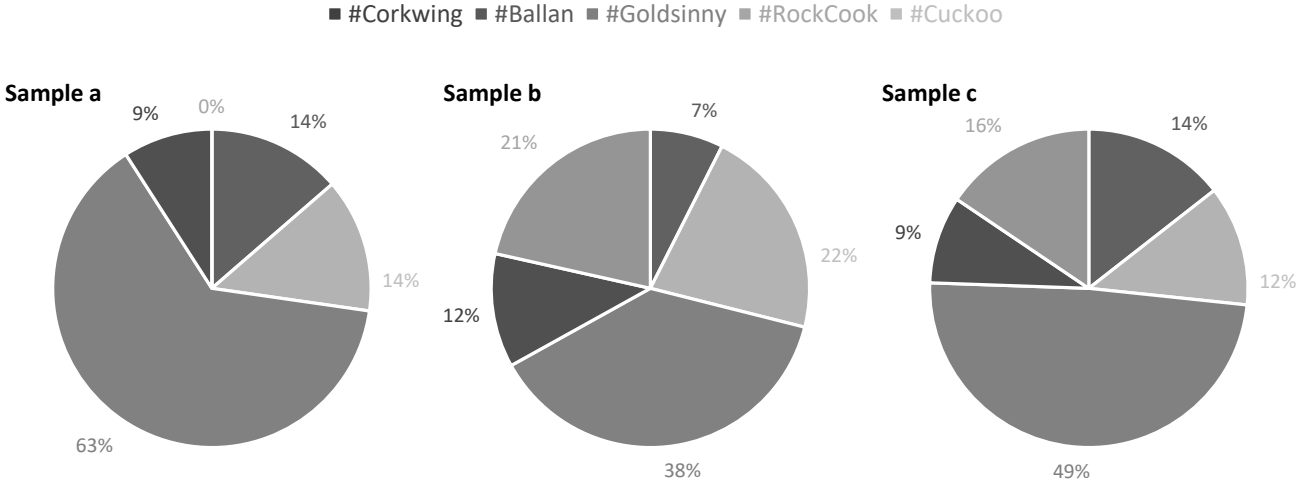

Figure 29: Catch composition of the wrasse species recorded at Rosemullion Head on 12th, 15th and 19th August 2019.

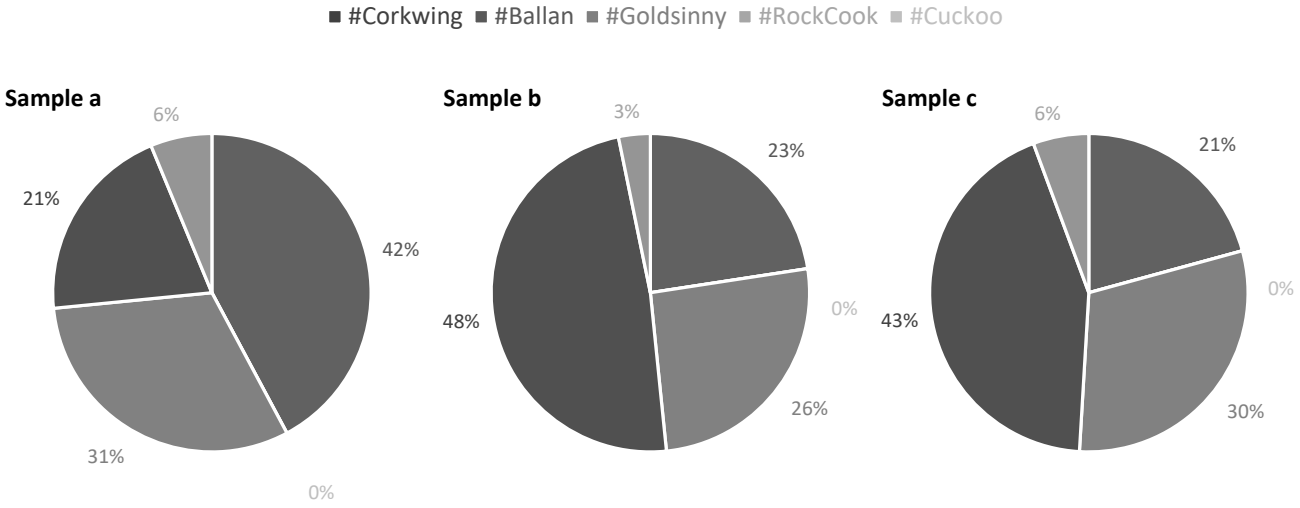

Figure 30: Catch composition of the wrasse species recorded at Mawnan to August Rock on 12th, 15th and 19th August 2019.

3.4.2 Length frequency

The total length of all wrasse species for each site can be seen in Figure 31 and Figure 33.

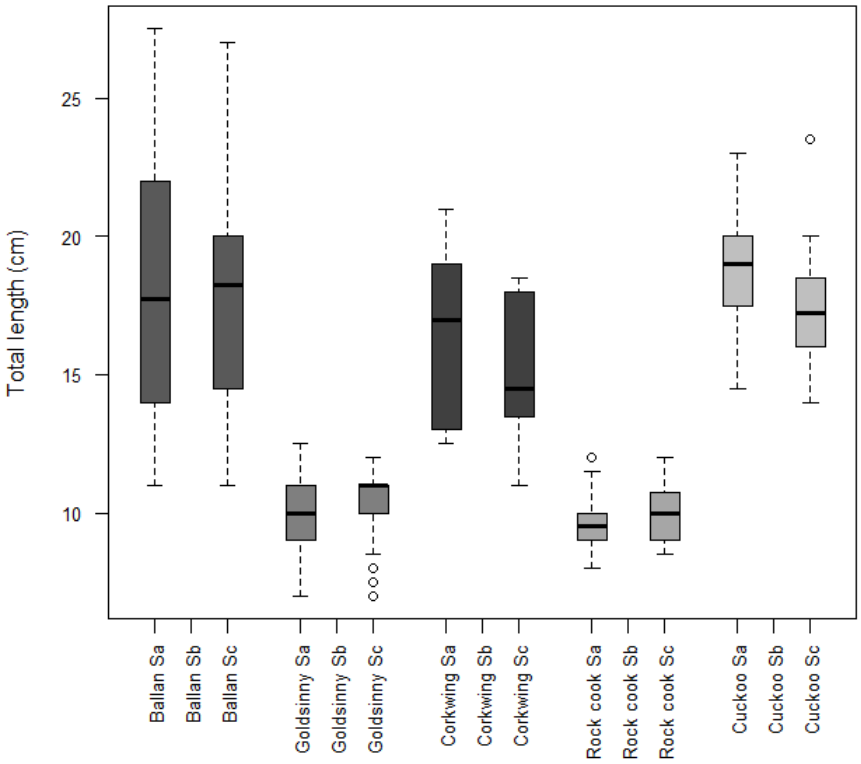

Figure 31: Total length in cm for ballan, goldsinny, corkwing, rock cook and cuckoo wrasse sampled at St Anthony Head. Data is grouped by sample (a, b and c) and by strings 1-3. Stripes show median, boxes show inter-quartile, error bars show range and hollow circles show outliers.

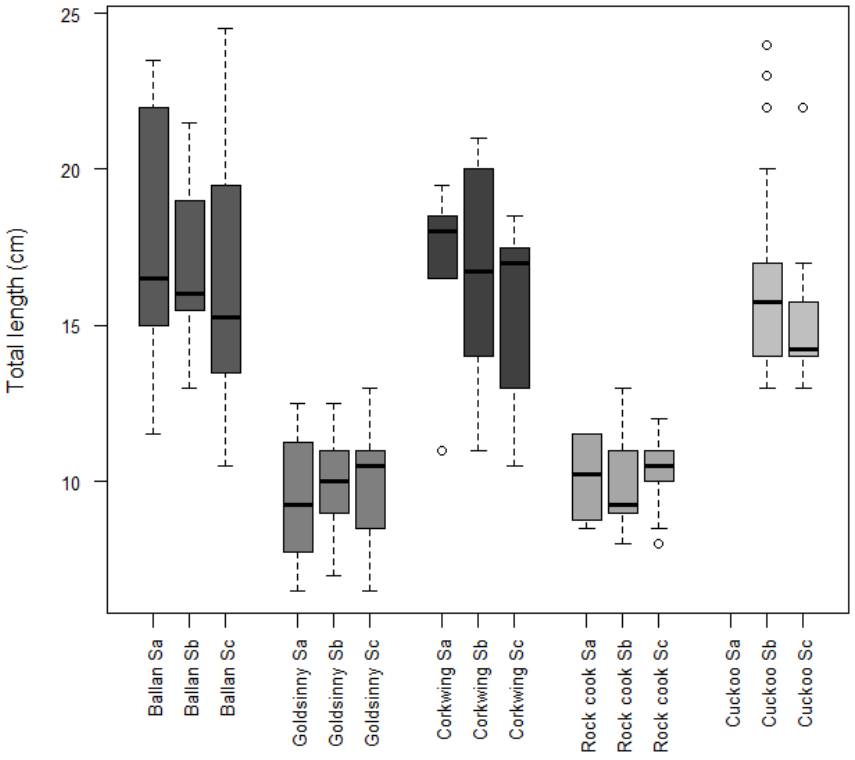

Figure 32: Total length in cm for ballan, goldsinny, corkwing, rock cook and cuckoo wrasse sampled at Rosemullion Head. Data is grouped by sample (a, b and c) and by strings 4,5 & 9. Stripes show median, boxes show inter-quartile, error bars show range and hollow circles show outliers.

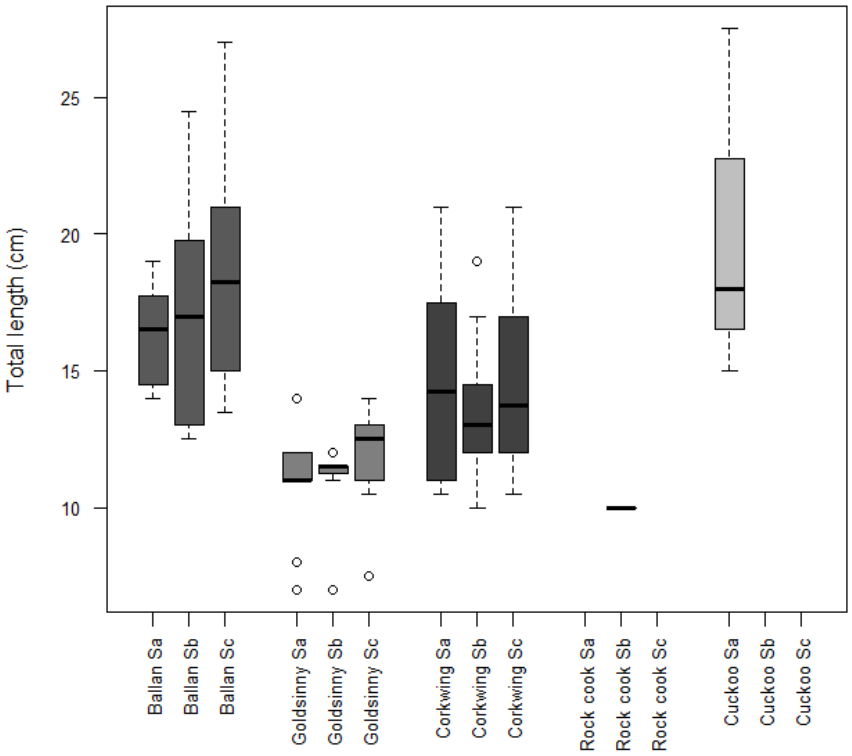

Figure 33: Total length in cm for ballan, goldsinny, corkwing, rock cook and cuckoo wrasse sampled at Mawnan to August Rock. Data is grouped by sample (a, b and c) and by strings 6-8. Stripes show median, boxes show inter-quartile, error bars show range and hollow circles show outliers.

3.4.3 Recaptures

The number of wrasse caught and recaptured during the fishery dependent sampling and the estimated population size can be seen in Table 7 to Table 9.

Table 7: Number of ballan, goldsinny, corkwing and rock cook caught, tagged and recaptured at St Anthony Head with the estimated population sizes for wrasse caught in traps.

Species	St Anthony Head												
	7th August 2019		12th August 2019		15th August 2019		19th August 2019		21st August 2019		Population size = N	95% Lower Confidence Interval	95% Upper Confidence Interval
	Caught	Tagged	Caught	Recaptured	Caught	Recaptured	Caught	Recaptured	Caught	Recaptured			
#Ballan	20	20	30	0	0	0	34	0	6	1	700	213	1365
#Goldsinny	35	33	28	0	0	0	39	0	36	1	1700	517	3315
#Corkwing	17	17	11	0	0	0	20	0	26	1	484	147	945
#RockCook	29	29	28	1	0	0	19	0	34	3	470	209	1124
Total#	101	99	97	1	0	0	112	0	102	6	3849	1996	8072

Table 8: Number of ballan, goldsinny, corkwing and rock cook caught, tagged and recaptured at Rosemullion Head with the estimated population sizes for wrasse caught in traps.

Species	Rosemullion Head												
	7th August 2019		12th August 2019		15th August 2019		19th August 2019		21st August 2019		Population size = N	95% Lower Confidence Interval	95% Upper Confidence Interval
	Caught	Tagged	Caught	Recaptured	Caught	Recaptured	Caught	Recaptured	Caught	Recaptured			
#Ballan	9	9	3	0	9	1	13	1	7	1	72	29	178
#Goldsinny	53	48	14	0	46	0	44	0	36	0	6720	1433	6720
#Corkwing	19	18	2	0	14	1	8	0	8	1	192	70	464
#RockCook	34	34	0	0	26	0	14	0	25	0	2210	471	2210
Total#	115	109	19	0	95	2	79	1	76	2	4887	2315	11176

Table 9: Number of ballan, goldsinny, corkwing and rock cook caught, tagged and recaptured at Mawnan to August Rock with the estimated population sizes for wrasse caught in traps.

Species	Mawnan to August Rock												
	7th August 2019		12th August 2019		15th August 2019		19th August 2019		21st August 2019		Population size = N	95% Lower Confidence Interval	95% Upper Confidence Interval
	Caught	Tagged	Caught	Recaptured	Caught	Recaptured	Caught	Recaptured	Caught	Recaptured			
#Ballan	8	8	27	0	7	1	11	2	11	1	87	39	209
#Goldsinny	19	18	20	0	8	0	16	0	13	0	1026	219	1026
#Corkwing	16	16	13	0	15	0	23	1	32	0	664	202	1295
#RockCook	26	26	4	1	1	1	3	0	46	3	234	111	535
Total#	69	68	64	1	31	2	53	3	102	4	1545	877	2933

During the fishery dependent sampling, only one tagged ballan wrasse was retained for sale. Two tagged ballan wrasse were of legal size but damaged so returned to sea and one was undersized and returned. A tagged ballan wrasse from the 2018 survey (Sturgeon *et al.,* 2018c) was of legal size but returned to the sea.

Movement of wrasse could be estimated from the original release site and the recaptured point during the fishery dependent sampling (Table 10). The potential maximum distance travelled is calculated from the furthest away release location within that site when there were multiples of the same sizes tagged. This was mainly for rock cook as they were one of the highest number tagged during the survey and their size distribution is narrow. Those without a potential maximum distance travelled were able to be identified as they had a unique size within the three strings tagged.

Table 10: Recaptured wrasse approximate distance travelled from original release location.

Site	Species	Size (cm)	Date caught	Approximate distance travelled (m)	Potential maximum distance travelled (m)
St Anthony Head	Rock cook	10	12/08/2019	37	526
Rosemullion Head	Ballan	15	15/08/2019	28	155
	Ballan	16	19/08/2019	43	89
	Corkwing	21	15/08/2019	28	-
Mawnan to August Rock	Rock cook	11.5	12/08/2019	130	800
	Rock cook	10	15/08/2019	20	856
	Ballan	24.5	15/08/2019	100	-
			19/08/2019	140	-
	Ballan	16	19/08/2019	132	-
	Corkwing	13	19/08/2019	15	-

3.4.4 By-catch

Bycatch was not able to be fully recorded during the fishery dependent sampling as there was not enough time to take a photograph of the contents of each pot. Only the capture of conger eels (*Conger conger*) were noted consistently for each trap. By-catch of conger eels in traps were considered to be responsible for non-direct fishing mortality. The numbers recorded per site can be seen in Table 11.

Table 11: Number of conger eels recorded per site during fishery dependent sampling on 12th, 15th and 19th August 2019.

Common name	Species name	Date	St Anthony Head Totals	Rosemullion Head Totals	Mawnan to August Rock Totals	All Sites Totals
Conger eel	*Conger conger*	12/08/2019	5	3	6	**14**
		15/08/2019	-	5	6	**11**
		19/08/2019	9	4	4	**17**

4 Discussion

4.1 Wrasse tagging

A total of 276 wrasse (excluding cuckoo) were tagged and 12 wrasse (excluding cuckoo) were recaptured from three different locations within Falmouth Bay. The estimated Petersen population sizes for wrasse caught in traps were smallest for ballan and largest for goldsinny (Table 2 to Table 4). However, care should be taken when interpreting the estimated population sizes of wrasse due to the small recapture rates and the assumptions for the estimates are noted below (Section 4.3).

The approximate area was calculated from each string with a 10 m buffer and combined for each site (Table 10). The buffer was based on approximately half the distance between each trap, allowing for some overlap. This was calculated as an indicative area to attribute the estimated population size to based on the perception that each trap had an 'influence' of a radius equal to half the distance between each trap. However, the actual area of influence of each trap is unknown as there are numerous environmental and behavioural variables (such as; currents, weather, topography, bait odour plume, natural prey, bait detection etc.) which are not accounted for and therefore the area for each site is not definitive. Officers have observed un-baited strings which have been hauled and contain a similar quantity of wrasse to baited traps (S Sturgeon, Pers. observation). For wrasse, the attraction to traps may not be directly due to bait but could be a form of shelter or inquisitiveness towards a new object within their territory.

The VIE tagging work that has been carried out so far in Falmouth Bay provides a baseline dataset and can form part of future Cornwall IFCA survey work to monitor the fishery in the form of a repeatable survey to look at differences of population estimates and catch composition between years.

4.2 Fishing activity

A total of 10 tagged wrasse (excluding cuckoo) were recorded during the three fishery dependent sampling days. Direct fishing mortality was observed with one tagged ballan wrasse from Mawnan to August Rock which was retained. Only one string at St Anthony Head was not observed by fishery dependent sampling in the period between the tagging and recapture. This string was hauled on 16th August and the fishers reported no tagged wrasse. The two remaining strings at St Anthony Head were not hauled that day due to adverse weather.

All recaptured wrasse were caught in the vicinity of the initial release sites which demonstrates their territorial behaviour. The maximum distance the recaptured wrasse could have travelled, dependent on original release location, was 155 m for ballan, 856 m for rock cook and 28 m for corkwing. No goldsinny were recaptured during the fishery dependent sampling.

Wrasse are highly territorial, and this is likely to influence their movement patterns and home range. A recent study looked at wrasse movement around three islands in Western Norway using Passive Integrated Transponder (PIT) tags (Aasen, 2019). Over two years 8,754 wrasse were tagged and 839 recaptured. Recaptures were highest for corking (n=631) and goldsinny (n=170). Aasen (2019) found that none of the five species of wrasse moved between the three islands which have stretches of open water from 470 m to 870 m with depths reaching 80 m. Corkwing

were found to move longer distances than goldsinny (corkwing max 592.2 m, mean 120.7 m; goldsinny max 385.6 m, mean 134.8 m). Aasen (2019) also found corkwing to move longer when larger. The maximum distance travelled for ballan (n=12) was 335.6 m (mean 104.6 m) and for rock cook (n=11) was 393.5 m (mean 134.8 m).

Wrasse occupy small spatial areas and Villegas-Rios *et al.* (2013) found ballan wrasse to have high site fidelity with small home ranges (91 m²) from acoustic telemetry in Galicia, Northwest Spain. Morel *et al.* (2013) also used acoustic telemetry to determine ballan wrasse movements in Portelet Bay, Jersey and they were found to be year round residents of the site and detections were most frequently by the receivers closest to their capture location indicating high site fidelity.

Nesting male corkwing are thought to have territories greater than 15 m² (Costello *et al.* 1995) and travel up to 50 m away from their nest site to collect certain algae species (Potts, 1985). Territories of goldsinny in Sweden did not change and were between 0.7 m² and 2 m², with a mean of 1.4 m² and foraging predominantly occurred within them (Hillden, 1981).

The estimated Schnabel population sizes for wrasse caught in traps over five sampling periods were significantly larger than the Peterson estimates. The estimated population sizes were again smallest for ballan and largest for goldsinny (Table 7 and Table 9). As previously mentioned, care should be taken when interpreting the estimated population sizes of wrasse due to the small recapture rates and the assumptions for the estimates are noted below (Section 4.3).

During the survey period non-direct fishing mortality was observed. Over the five sampling days, a total of seven wrasse (five goldsinny, one corkwing and one cuckoo) were caught dead. Three goldsinny could not be measured and it is not known if they were tagged. The cause of death was likely to be attributed to the by-catch within the trap. During the fishery dependent sampling officers observed goldsinny in the stomach of conger eels and the total number of non-direct fishing mortality from conger eels is unknown.

A ballan wrasse caught on 7th August 2019 was previously tagged during the Wrasse Tagging Falmouth Bay Survey 2018 (Sturgeon *et al.,* 2018c) and was recaptured again on 19th August 2019. This individual demonstrated tag retention for up to nine months. Two of the wrasse recaptured, one corkwing and one ballan, only had one VIE tag visible which demonstrated the importance of double marking.

4.3 Population Size Estimations

The Petersen model and Schnabel method estimates only refers to the catchable proportion of the population of wrasse in traps, which is not the entire population for each species. For example, the entrance of the traps are selective to exclude larger wrasse. This mainly excludes ballan wrasse over 30 cm and they are known to grow up to 60 cm (Darwall *et al.,* 1992). The escape gaps remained open which meant the smaller species of wrasse had a low probability of being retained.

For the estimation of population size to be accurate the Petersen model and Schnabel method depends on meeting the following assumptions:

1. The population is closed (geographically and demographically).
2. All individuals within each sample are equally likely to be captured.
3. Capture and tagging does not affect catchability.
4. Each sample is random.
5. Tags are not lost between sampling.
6. All tags are recorded correctly and detected upon recapture.

The Schnabel method requires the assumptions to apply to all samples.

For the first assumption to hold, the time between tagging and recapture should be over a short period of time. In the first instance this was 14 days after tagging, although the first fishery dependent sampling day for fishing monitoring was five days after tagging.

Assumption 2, that all individuals within each sample are equally likely to be captured, is difficult for wrasse. The capture probability of a wrasse being caught in a trap is dependent on multiple variables. Variation in capture probability can be because of sex, age, social status, size, behaviour and time (e.g. effects of weather or sampling effort). Halvorsen et al., (2016) found corkwing males have a higher catch probability in baited traps than females.

Capture probablity did vary between fishery dependent samples as the strings in each site were moved further offshore after the initial tagging survey due to upcoming adverse weather. Therefore the capture probabilty varies among fishery dependent sampling days due to distance of strings from the tagged release sites.

Every attempt was made to ensure there was no bias in mark and recapture. To fulfill assumption 5, each wrasse was double marked to reduce the risk of losing a tag. A controlled tag retention and tag related mortality study, prior to this survey, could not be carried out due to limited facilities for husbandry. It was assumed tag retention rates were 100%. However, three of the 22 recaptured wrasse only had one tag which shows the importance of double marking. Therefore, it should be noted that tag retention rates may also explain why there was a low recapture rate. Tag retention rates were dependent on various variables such as trailing material, handling, material curing and wound healing. No mortality of wrasse was observed during the study and all wrasse swam down below the sea surface when returned. Tag related mortality was assumed to be 0%. As each individual wrasse was carefully screened for tags this ensured all marks were recorded correctly and reported on recapture, thus meeting assumption 6.

Another possibility for the low recapture rate may have been because of the sample size tagged for the locations. The Petersen model is bias to small sample sizes and tends to overestimate the actual population which is why the Chapman modification was used in the analysis. The results of the estimated population sizes produced wide confidence intervals which is down to the number of wrasse recaptured being small or zero, therefore the

population estimates are not reliable. It is recommended that a survey has enough wrasse tagged in the first sampling period and the second sample is large enough to ensure that more than seven tagged wrasse are recpatured, then the bias of the Chapman equation can be considered negligible (Robson and Regier, 1964).

4.4 Limitations and recommendations for future surveys

The limitations in this study and recommendations to minimise these on future surveys are shown below.

4.4.1 Water parameters

A profile using Cornwall IFCA's Valeport Swift Sound Velocity Profiler (SVP) should be taken at each site to determine sound velocity, pressure, temperature, salinity and density. Secchi disks should be taken on every survey on hauling and setting days to determine water visability, as it is considered that this may have an influence on the catch rates.

4.4.2 Location of strings

The areas which were surveyed were locations that are subject to fishing activity. Locations which have previously been unfished and that are within the closed areas of the Live Wrasse Fishing (Limited Permit) Byelaw would be beneficial as control sites to draw comparisons on any changes to catch over time in fished and unfished areas.

4.4.3 Population estimate

The Petersen model and Schnabel method are based on assumptions which need to be met for the estimate of population size to be accurate and these have been discussed in Section 4.3.

.

5 References

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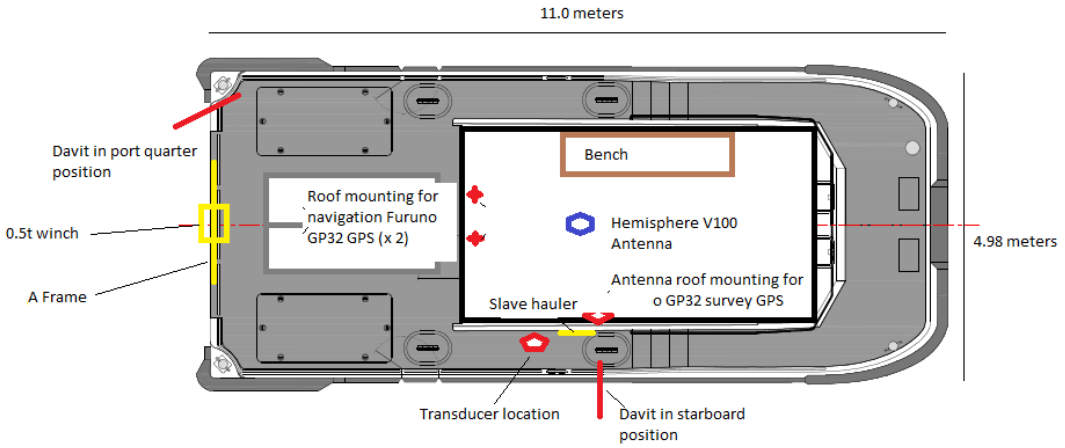
6 Appendices

Annex 1 – RV Tiger Lily vessel specification, deck plan and offsets

Builder	South Boats Ltd
Model	Island MkII
Built	2007
LOA	11.0m
Beam	4.98m
Draught	1.1m (aft)
Tonnage	c.10 tonnes
Area of operation	MCA Category 2
Call sign	MRWR7
MMSI Number	235054954
MECAL Certification number	M07WB0111059
Complement	14 (including min 2 crew)
Propulsion	2 x 450hp Iveco NEF series
Speed	Cruising: 16 – 18 knots Top: 24 – 26 knots
Range	c. 400 nautical miles
240v AC supply	Victron 3Kw power inverter 5KvA Volvo-Perkins generator (All 240 AC power is accessed via APC Smart UPS C1500)
Stern Gantry	500kg SWL
Winch (on stern gantry)	Spencer Carter 0.5t with scrolling level wind
Slave hauler	Sea Winch 200m dia.
Electric line hauler	12v Spencer Carter Bandit

Positioning	Hemisphere V100 GNSS 3 x Furuno GP32
NMEA data outputs	4 x USB 4 x Serial 4 x banjo
Navigation	Olex with data export Knockle Hypack Max

Tiger Lily VI General Layout - Plan view



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

Annex 2 – Ingestion of Visible Implant Elastomer

Northwest Marine Technology, Inc.

13 May, 2014

Ingestion of Visible Implant Elastomer

Northwest Marine Technology's Visible Implant Elastomer (VIE) is made from a two part silicon-based material that is mixed together just before tagging. One part is the "curing agent" and the other part is the silicon base. It is injected as a liquid and cures to a pliable solid. About 90% of the VIE is comprised of the pigment and a medical grade silicone which is approved in the United States for surgical implants in humans, specifically for breast implants. Like all silicones used for human implants, ours uses the non-toxic platinum catalysts.

The manufacturer of the pigment states "The pigments … have been pre-approved through Duke University for the ACMI certification program. They are essentially non-toxic and contain no constituent heavy metals or inorganic phosphors." (ACMI stands for Arts and Crafts Manufacturers Institute who approves materials used for things like crayons, paints, and children's toys; www.acminet.org).

We have not applied for approval of VIE as a food additive by the Food and Drug Administration (i.e. it is not approved by the FDA for consumption), and therefore, when possible, encourage people to tag in body parts that would not be consumed. On the other hand, we know that the elastomer has been consumed, including by some people in our office, and there have been no reports of ill effects.

G E Vander Haegen

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Annex 3 – Daily Logs

5th August 2019 – Wrasse Tagging Falmouth Bay Survey

Project information		
Project	Wrasse Tagging Project 2019	
Survey code	20190805_CIFCA_Wrasse	
Location	Falmouth Bay	
Date	5th August 2019	
Vessel	Commercial Fishing Vessel	
Staff		
Survey role	**Company**	**Name**
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon
Scientific Officer	Cornwall IFCA	Hilary Stidwell

Weather and tides	
High water time (Falmouth):	08:20
High water (m)	5.08
Weather recorded	07:00
Wind direction	WSW
Wind speed	10-17 mph
Beaufort scale	2
Cloud coverage	1/8

Safety	
Toolbox talk time	N/A
Induction	N/A

Summary of operations		
Time start (UTC)	**Time end (UTC)**	**Activity**
06:40:00		Depart Mylor
09:31:16	09:44:42	Haul string 1
09:46:59	09:48:19	Shot string 1
09:53:15	10:07:48	Haul string 2
10:12:16	10:13:27	Shot string 2
10:17:34	10:32:37	Haul string 3
10:38:56	10:40:18	Shot string 3
11:09:40	11:21:38	Haul string 4
11:24:12	11:25:26	Shot string 4
11:27:11	11:40:27	Haul string 5
11:46:56	11:48:06	Shot string 5
11:55:49	12:08:44	Haul string 6
12:12:41	12:14:15	Shot string 6
12:17:34	12:31:23	Haul string 7

12:35:41	12:36:50	Shot string 7
12:41:23	12:54:16	Haul string 8
12:56:24	13:07:01	Haul string 9
13:15:05	13:16:23	Shot string 9
13:24:33	13:25:52	Shot string 8
14:40:00		Arrive Mylor

7th August 2019 – Wrasse Tagging Falmouth Bay Survey

Project information	
Project	Wrasse Tagging Project 2019
Survey code	20190807_CIFCA_Wrasse_Tagging
Location	Falmouth Bay
Date	7th August 2019
Vessel	Tiger Lily VI

Staff		
Survey role	**Company**	**Name**
Principal Scientific Officer	Cornwall IFCA	Colin Trundle
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon
Scientific Officer	Cornwall IFCA	Hilary Stidwell
Skipper	Independent	David Raymond
Visitor	Exeter University Student	

Weather and tides	
High water time (Falmouth):	09:49
High water (m)	4.65
Weather recorded	07:10
Wind direction	W
Wind speed	16-20 mph
Beaufort scale	2
Cloud coverage	6/8

Safety	
Toolbox talk time	06:45
Induction	06:35

Summary of operations		
Time start (UTC)	**Time end (UTC)**	**Activity**
06:35		On board Tiger Lily and setting up
06:45		Toolbox talk
06:55		Depart Mylor
07:00		Collected bait from Mylor Quay
07:08		Depart Mylor Quay
07:27	07:57	Haul string 3
08:07	08:08	Shot string 3
08:13		Fish released from pots 1-5, string 3
08:15		Fish released from pots 6-10, string 3
08:23	08:50	Haul string 2
08:54		Fish released from pots 1-5, string 2
08:56		Fish released from pots 6-10, string 2

09:01	09:02	Shot string 2
09:13	09:43	Haul string 1
09:47		Fish released from pots 1-5, string 1
09:48		Fish released from pots 6-10, string 1
09:52	09:54	Shot string 1
10:17	10:39	Haul string 6
10:43		Fish released from pots 1-5, string 6
10:45		Fish released from pots 6-10, string 6
10:48	10:49	Shot string 6
10:56	11:21	Haul string 8
11:25		Fish released from pots 6-10, string 8
11:27		Fish released from pots 6-10, string 8
11:29	11:31	Shot string 8
11:35	11:56	Haul string 7
12:01		Fish released from pots 6-10, string 7
12:02		Fish released from pots 1-5, string 7
12:04	12:06	Shot string 7
12:58	13:16	Haul string 5
13:21		Fish released from pots 6-10, string 5
13:23		Fish released from pots 1-5, string 5
13:26	13:27	Shot string 5
13:32	13:51	Haul string 4
13:59		Fish released from pots 1-5, string 4
14:00		Fish released from pots 6-10, string 4
14:03	14:04	Shot string 4
14:10	14:37	Haul string 9
14:41		Fish released from pots 1-5, string 9
14:43		Fish released from pots 6-10, string 9
14:48	14:50	Shot string 9
14:55		Clean deck and steam back to Mylor
15:29		Arrive Mylor

12th August 2019 – Wrasse Tagging Falmouth Bay Survey

Project information		
Project	Wrasse Tagging Project 2019	
Survey code	20190812_CIFCA_Wrasse	
Location	Falmouth Bay	
Date	12th August 2019	
Vessel	Commercial Fishing Vessel	
Staff		
Survey role	**Company**	**Name**
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon

Weather and tides	
High water time (Falmouth):	15:18
High water (m)	4.51
Weather recorded	06:30
Wind direction	NW
Wind speed	9-15 mph
Beaufort scale	2
Cloud coverage	2/8

Safety	
Toolbox talk time	N/A
Induction	N/A

Summary of operations		
Time start (UTC)	**Time end (UTC)**	**Activity**
06:20:00		Depart Mylor
06:52:00	07:05:00	Haul string 1
07:05:52	07:07:08	Shot string 1
07:09:00	07:19:00	Haul string 2
07:20:47	07:21:54	Shot string 2
07:25:00	07:34:00	Haul string 3
07:39:09	07:40:28	Shot string 3
11:45:00	11:54:00	Haul string 4
11:55:20	11:56:06	Shot string 4
11:58:00	12:07:00	Haul string 5
12:08:00	12:09:16	Shot string 5
12:17:00	12:23:00	Haul string 6
12:26:25	12:27:36	Shot string 6
12:39:00	12:45:00	Haul string 7
12:48:21	12:49:26	Shot string 7
12:53:00	12:58:00	Haul string 8

13:00:56	13:14:02	Shot string 8
13:04:00	13:09:00	Haul string 9
13:13:18	13:14:19	Shot string 9
14:15:00		Arrive Mylor

15th August 2019 – Wrasse Tagging Falmouth Bay Survey

Project information		
Project	Wrasse Tagging Project 2019	
Survey code	20190815_CIFCA_Wrasse	
Location	Falmouth Bay	
Date	15th August 2019	
Vessel	Commercial Fishing Vessel	
Staff		
Survey role	**Company**	**Name**
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon

Weather and tides	
High water time (Falmouth):	05:05
High water (m)	4.73
Weather recorded	05:30
Wind direction	W
Wind speed	15-26 mph
Beaufort scale	4
Cloud coverage	4/8

Safety	
Toolbox talk time	N/A
Induction	N/A

Summary of operations		
Time start (UTC)	**Time end (UTC)**	**Activity**
05:20:00		Depart Mylor
10:08:06	10:17:16	Haul string 1
10:20:59	10:22:06	Shot string 1
10:24:50	10:33:32	Haul string 2
10:36:55	10:38:24	Shot string 2
10:45:55	10:54:26	Haul string 3
10:57:09	10:58:20	Shot string 3
11:03:09	11:12:42	Haul string 4
11:16:03	11:17:23	Shot string 4
11:20:57	11:27:19	Haul string 5
11:30:42	11:32:08	Shot string 5
11:50:38	11:59:58	Haul string 6
12:02:32	12:03:43	Shot string 6
12:06:02	12:13:51	Haul string 7
12:16:24	12:17:26	Shot string 7
12:19:09	12:26:41	Haul string 8

12:29:40	12:30:59	Shot string 8
13:51:00		Arrive Mylor

19th August 2019 – Wrasse Tagging Falmouth Bay Survey

Project information		
Project	Wrasse Tagging Project 2019	
Survey code	20190819_CIFCA_Wrasse	
Location	Falmouth Bay	
Date	19th August 2019	
Vessel	Commercial Fishing Vessel	
Staff		
Survey role	**Company**	**Name**
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon

Weather and tides	
High water time (Falmouth):	07:28
High water (m)	4.8
Weather recorded	05:30
Wind direction	W
Wind speed	14-22 mph
Beaufort scale	2
Cloud coverage	2/8

Safety	
Toolbox talk time	N/A
Induction	N/A

Summary of operations		
Time start (UTC)	**Time end (UTC)**	**Activity**
05:20:00		Depart Mylor
05:48:26	05:56:54	Haul string 1
06:01:37	06:02:43	Shot string 1
06:06:27	06:14:52	Haul string 2
06:21:33	06:22:47	Shot string 2
06:26:49	06:36:46	Haul string 3
06:41:49	06:43:13	Shot string 3
10:35:52	10:42:16	Haul string 4
10:46:06	10:47:31	Shot string 4
10:50:29	10:56:21	Haul string 5
10:58:19	10:59:44	Shot string 5
11:03:00	11:08:11	Haul string 6
11:12:45	11:13:59	Shot string 6
11:21:36	11:28:12	Haul string 7
11:34:11	11:35:18	Shot string 7
11:40:55	11:48:01	Haul string 8

11:49:42	11:51:14	Shot string 8
12:09:09	12:15:27	Haul string 9
12:19:10	12:20:13	Shot string 9
12:23:46	12:29:44	Haul string 10
12:31:54	12:33:04	Shot string 10
12:36:06	12:41:13	Haul string 11
12:44:31	12:45:41	Shot string 11
14:00:00		Arrive Mylor

21st August 2019 – Wrasse Tagging Falmouth Bay Survey

Project information			
Project	Wrasse Tagging Project 2019		
Survey code	20190821_CIFCA_Wrasse_Tagging		
Location	Falmouth Bay		
Date	21st August 2019		
Vessel	Tiger Lily VI		
Staff			
Survey role	**Company**	**Name**	
Principal Scientific Officer	Cornwall IFCA	Colin Trundle	
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon	
Scientific Officer	Cornwall IFCA	Annie Jenkin	
Skipper	Independent	David Raymond	
Visitor	Exeter University Student		
Weather and tides			
High water time (Falmouth):		08:21	
High water (m)		4.59	
Weather recorded	06:00	10:30	
Wind direction	SW	SW	
Wind speed	6-11 mph	12-14 mph	
Beaufort scale	1	3	
Cloud coverage	1/8	8/8	
Safety			
Toolbox talk time	06:44		
Induction	N/A		
Summary of operations			
Time start (UTC)	**Time end (UTC)**	**Activity**	
06:00:00		On board Tiger Lily and setting up	
06:30:00		Depart Mylor	
06:35:00		Collected bait from Mylor Quay	
06:40:00		Depart Mylor Quay	
06:45:00		Toolbox talk	
07:00:07	07:23:22	Haul string 2	
07:25:39		Fish released 6-10 string 2	
07:27:27		Fish released 1-5 string 2	
07:44:10	07:45:32	Shot string 2	
07:49:26	08:13:49	Haul string 3	
08:16:43		Fish released 6-10 string 3	
08:18:03		Fish released 1-5 string 3	

08:20:51	08:22:20	Shot string 3
08:26:30	08:49:13	Haul string 1
08:51:56		Fish released 6-10 string 1
08:53:16		Fish released 1-5 string 1
08:56:23	08:57:38	Shot string 1
09:13:36	09:34:54	Haul string 6
09:38:30		Fish released 6-10 string 6
09:39:49		Fish released 1-5 string 6
09:43:08	09:44:41	Shot string 6
09:47:22	10:12:54	Haul string 8
10:15:41		Fish released 6-10 string 8
10:16:44		Fish released 1-5 string 8
10:19:19	10:20:43	Shot string 8
10:24:50	10:44:21	Haul string 7
10:47:21		Fish released 6-10 string 7
10:48:32		Fish released 1-5 string 7
10:50:22	10:51:50	Shot string 7
11:43:41	12:01:30	Haul string 5
12:03:54		Fish released 6-10 string 5
12:05:18		Fish released 1-5 string 5
12:08:15	12:09:57	Shot string 5
12:14:43	12:30:56	Haul string 4
12:34:50		Fish released 6-10 string 4
12:35:52		Fish released 1-5 string 4
12:38:25	12:39:40	Shot string 4
12:43:25	13:03:33	Haul string 9
13:07:23		Fish released 6-10 string 9
13:09:29		Fish released 1-5 string 9
13:12:35	13:13:54	Shot string 9
13:15:00		Clean deck and steam back to Mylor
13:45:00		Arrive Mylor