Southern IFCA
Inshore Fisheries and Conservation Authority

Live Wrasse Fishery Report 2020

January 2021

Live Wrasse Fishery Report 2020

Created by Southern Inshore Fisheries and Conservation Authority (Southern IFCA)

Authors: Chloe Smith & Lauren Henly

Document History

Date	Version	Editor	Change	Approver
19/11/2020	1.0	C Smith		
20/11/2020	1.1	C Smith	Additions to Major Sections	
04/12/2020	1.2	C Smith	Additions to Major Sections	
06/01/2021	1.3	C Smith	Additions to Major Sections	
12/01/2021	1.4	C Smith	Additions to Major Sections	
13/01/2021	1.5	C Smith	Additions to Major Sections	
16/01/2021	1.6	C Smith	Minor Edits & Summary	
17/02/2021	1.7	C Smith	Minor Edits	
19/01/2021	1.8	C Smith	Addition of 2020 effort map	
19/01/2021	1.9	C Smith	L. Henly & S. Pengelly Comments Addressed	
19/01/2021	2.0	C Smith	Word crashed recovered version	
24/01/2021	2.1	C Smith	L. Henly Comments addressed	S. Pengelly
26/01/2021	2.2	C Smith	S. Pengelly Comments addressed	

Southern IFCA Live Wrasse Fishery Report 2020

This report may be cited as:

Smith, C & Henly, L. 2021. Southern IFCA Live Wrasse Fishery Report 2020. Southern Inshore Fisheries and Conservation Authority (Southern IFCA). Poole. https://www.southern-ifca.gov.uk/ January 2021

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

Southern IFCA

Unit 3, Holes Bay Park
Sterte Avenue West
Poole
Dorset
BH152AA

Tel: 01202 721373

Email: Enquiries@southern-ifca.gov.uk

Executive Summary

The Southern IFCA live wrasse fishery supplies ballan, corkwing, goldsinny, rock cook and baillon's wrasse to UK Salmon farms for use as live pest control within salmon cages. The fishery is relatively new to the South Coast. In the Southern IFC District, wrasses are removed from the Weymouth and Portland areas, in and around the Studland to Portland Special Area of Conservation (SAC).

In accordance with requirements under the Habitats Regulations 2017, the fishery has been assessed through Habitats Regulations Assessments (HRAs) in order to ensure, the fishery does not lead to an adverse effect on the SAC's site integrity. As a part of the mitigation to ensure this does not occur 'Wrasse Fishery Guidance' and a Monitoring and Control Plan (M&CP) have been developed. The M&CP forms the basis for this fishery report.

In 2019 fishing within the SAC around the Isle of Portland increased due to a shift from pot fishing, to rod and line fishing in order to target ballan wrasse. Following this, in 2020, demand for ballan wrasse subsided, returning the fishery to a pot dominated fishery for corkwing and goldsinny wrasses, with activity occurring mostly outside of the SAC.

Catch return forms submitted voluntarily by fishers were used to asses changes in Landings Per Unit of Effort (LPUE) between 2018, 2019 and 2020. Analysis of the data using Generalised Linear Models found that LPUE of total wrasses caught in pots had not changed significantly over the three-year period.

Further analysis indicated that LPUE of ballan wrasse in both pots and using rod and line have increased. This may suggest that the ballan wrasse stock could be increasing however, the reduction in demand for this species in 2020 may have enabled more fish to be caught within pots than in previous years.

Mixed wrasse LPUE was found to decline between 2018 and 2019 however, it is not possible to attribute this to fishery affects due to limitations of the analysis. A further decline in mixed wrasse in 2020 is most likely due to a change in fishery practise, where fishers only retained two of the four wrasse species in 2020, resulting in the catch of two species not being recorded. In order to monitor this, the LPUE of individual wrasse species will be closely monitored throughout the 2021 wrasse fishery season.

Portland Harbour/ Weymouth Bay show a consistently higher LPUE, whilst Ringstead Bay gives rise to a significantly lower LPUE. Rod and line fishing of the Isle of Portland shows a significantly higher LPUE than rod and line fishing elsewhere.

Seasonality effects on wrasse LPUE were found, with Ballan wrasse LPUE increasing throughout the season, whilst mixed wrasses LPUE declined throughout the season. Literature confirms that many of the wrasse species are more abundant during the summer, declining in autumn/ winter.

Overall, the analysis of Southern IFCA wrasse fishery data does not indicate that the fishery at its current level is being fished unsustainability. Data collection has improved year on year, and should be improved further with more species-specific data and tighter reporting deadlines. Analysis has been carried out only on fish which fall between minimum and maximum conservation reference sizes which may mask effects on younger or older cohorts. Annual monitoring of 'catch' as well as landings would add confidence to this assessment.

Contents

1 Introduction

Historically, salmon farms used a range of chemical treatments in order to control populations of damaging sea lice within their salmon stocks. More recently, concerns regarding the long-term effectiveness of chemical treatments and the impact of those chemicals to the wider marine environment has seen measures introduced to restrict their use. This has led to the increasing use of live wrasse as a method of controlling sea lice in Scottish salmon farms. Wrasse species (*Labrus bergylta* - ballan, *Symphodus melops* - corkwing, *Centrolabrus exoletus* – rock cook, Ctenolabrus rupestris – goldsinny, *Symphodus bailloni* - baillon's) are particularly effective cleaner fish for the removal of sea lice within salmon cages, as this behaviour is one which they express in their natural open water environments (Bjordal, 1988).

Additionally, the industry has recognised the benefits of using cleaner fish. The popularity of the method has increased over the past 5 years as Salmon farms look for more environmentally friendly farming techniques which increase the status of their products. Whilst the capture of wrasse for these purposes has been carried out widely in Scotland and off of the Norwegian coast, a live wrasse fishery is fairly new to the South West of England. Higher demand for wrasse has meant that farming companies are having to source stock from around the UK in order to meet demand without exhausting local populations (L Bennett, R Hawkins pers. comm. 2017).

Figure 1. Corkwing *wrasse (Symphodus melops)*

1.1 Southern IFCA Live Wrasse Fishery

In the Southern IFCA District fishing for wrasse using traps began as a small-scale experimental fishery around 2015/16. Since those initial trails, the fishery has seen a gradual increase in the number of fishers who partake in the fishery. For those fishers involved the live wrasse fishery has become a very important summer fishery and a major source of income. The wrasse fishery in Southern IFCA takes place around Weymouth and the Isle of Portland. In this area, a Special Area of Conservation is also designated for its fine examples of temperate reef habitats.

Early on, static fish traps were used to trap wrasse for live transport to salmon farms in Scotland. For the first three years, the fishery was active predominantly between April and October each year with a maximum of ten known participants, all using vessels measuring eight meters or less in length.

In response to the developing fishery, an industry led management approach was developed by Southern IFCA in collaboration with Cornwall IFCA and Devon and Severn IFCA, where similar fisheries existed. This led to the creation of the 'Wrasse fishery Guidance Measures' by Southern IFCA (See 'IN FOCUS' page 6). The success of these measures was dependent on an agreement with wrasse buyers and subsequently fishers.

The introduction of the 'Guidance Measures' drove a change in the fishery. The precautionary species conservation reference size for the largest species, ballan wrasse, meant that fewer ballan wrasse caught in the traps could be retained. Following this, some participants trialled the use of rod and line to specifically target ballan wrasse. In 2018, fishers moved to using rod and line as their main method of ballan wrasse

capture. A small number of the fishers continued to use traps to catch the other four wrasse species (Corkwing, Goldsinny, Rock cook and Baillon's). In 2019, the majority of fishers used rod and line as their primary capture method. However, due to a change in fishery demand in 2020, where corkwing and goldsinny wrasse were preferred by salmon farms, all but two of the fishers returned to fishing using traps only. In 2020, nine fishers were active in the live wrasse fishery around Weymouth and Portland.

In 2016 and 2017, wrasse (pot) fishing effort was concentrated between the Isle of Portland and Lulworth, with key areas from White Nothe to Ringstead and Portland Breakwater. In 2018 and 2019, rod and line fishing predominantly occurred off of Portland Bill.

In 2020, fishery activity was spread over areas predominantly outside of the Studland to Portland SAC, such as Ringstead Bay, Portland Harbour and Balaclava Bay.

1.1.1 Monitoring and Control Plan

In 2018, Southern IFCA undertook a Habitats Regulations Assessment (HRA) of the wrasse pot fishery. As a part of this process mitigation in the form of the Wrasse Fishery Guidance and a Monitoring and Control Plan were included to ensure the wrasse fishery did not lead to an adverse effect on the Studland to Portland SAC. The 'Monitoring and Control Plan' describes a wide variety of ways in which the fishery is monitored each year. A number of parameters have been set, which if triggered, require a review of the fishery. In 2019, following the introduction of a new method for live wrasse capture, rod and line, Southern IFCA completed a second HRA to assess the impacts of the fishery on the SAC, as per the requirements of the Monitoring and Control Plan.

The targets described in the Southern IFCA Wrasse Fishery Monitoring and Control Plan form the basis for this annual Wrasse Fishery Report.

2 Methodology

2.1 Data collection

Southern IFCA wrasse fishery guidance measures stipulate that participants (and buyers) in the fishery should submit data regarding their catches and bought stock for each season.

Therefore, throughout the fishing season Southern IFCA receives information on the total number of wrasses bought by each of the buyers. Similarly, each participant in the fishery voluntarily submits catch return forms (CRF) for every month of the season they have fished.

In 2018, following the creation of the guidance in 2017, the catch return form was trialled. Subsequently in 2019, Southern IFCA worked with fishers to improve the way in which data is recorded and submitted to better inform management needs. The CRF was redesigned to enable data to be submitted and assessed more easily (Annex 1).

Wrasse catch return forms require the fishers to submit data on the number of wrasses caught. Due to the way the fishery for some time

IN FOCUS

'WRASSE FISHERY GUIDANCE MEASURES'

These 'Wrasse Fishery Guidance Measures', were introduced in 2017. They were chosen to protect the long-term sustainability of wrasse populations and to maximise the enjoyment of the species by other users.

Conservation Reference Sizes:

Ballan wrasse (*Labrus bergylta*): 18cm to 28cm;

Corkwing wrasse (*Symphodus melops*): 14cm to 22cm;

Rock cook wrasse (*Centrolabrus exoletus*) and Goldsinny wrasse (*Ctenolabrus rupestris*): 12cm to 18cm;

all Cuckoo wrasse (*Labrus mixtus*) should be returned to the fishery immediately

Six '**No Take Zones** and a **'No Potting Zone'**.

10m **Maximum fishing depth**

Pot vessel limit set at 80

Closed Season 1st April to 30th June

Catch data by way of sales notes and monthly catch return forms.

Appropriate **Biosecurity and husbandry measures** should be followed

Throughout each fishing season Southern IFC Officers inspect catches, and transport lorries for compliance with these measures.

targeted ballan wrasse more heavily than the other four wrasse species, Ballan wrasse are counted and recorded separately. The other four wrasse species are recorded as a single number of 'Mixed Species' due to the way in which the fish are stored and sold to minimise the potential for mortality associated with handling. Units of effort are also required on the catch return forms. For potting this includes the number of pots hauled and time soaked. For rod and line fishing this includes the number of rods used and the time spent fishing. For each fishing trip fishers are also required to record the area in which they have fished. There are eight 'Wrasse Fishing Areas' (Figure 2).

In 2018 and in some of the following year's data, effort data was not fully submitted. Where it was not possible to obtain the missing data, estimates were made based on knowledge of previous fishing activity. For example, if soak time was missing, this was calculated based on the time difference between the previous date of a fishing trip, and the date of the trip for which data was missing. Further solutions to incomplete data can be found in Annex 2.

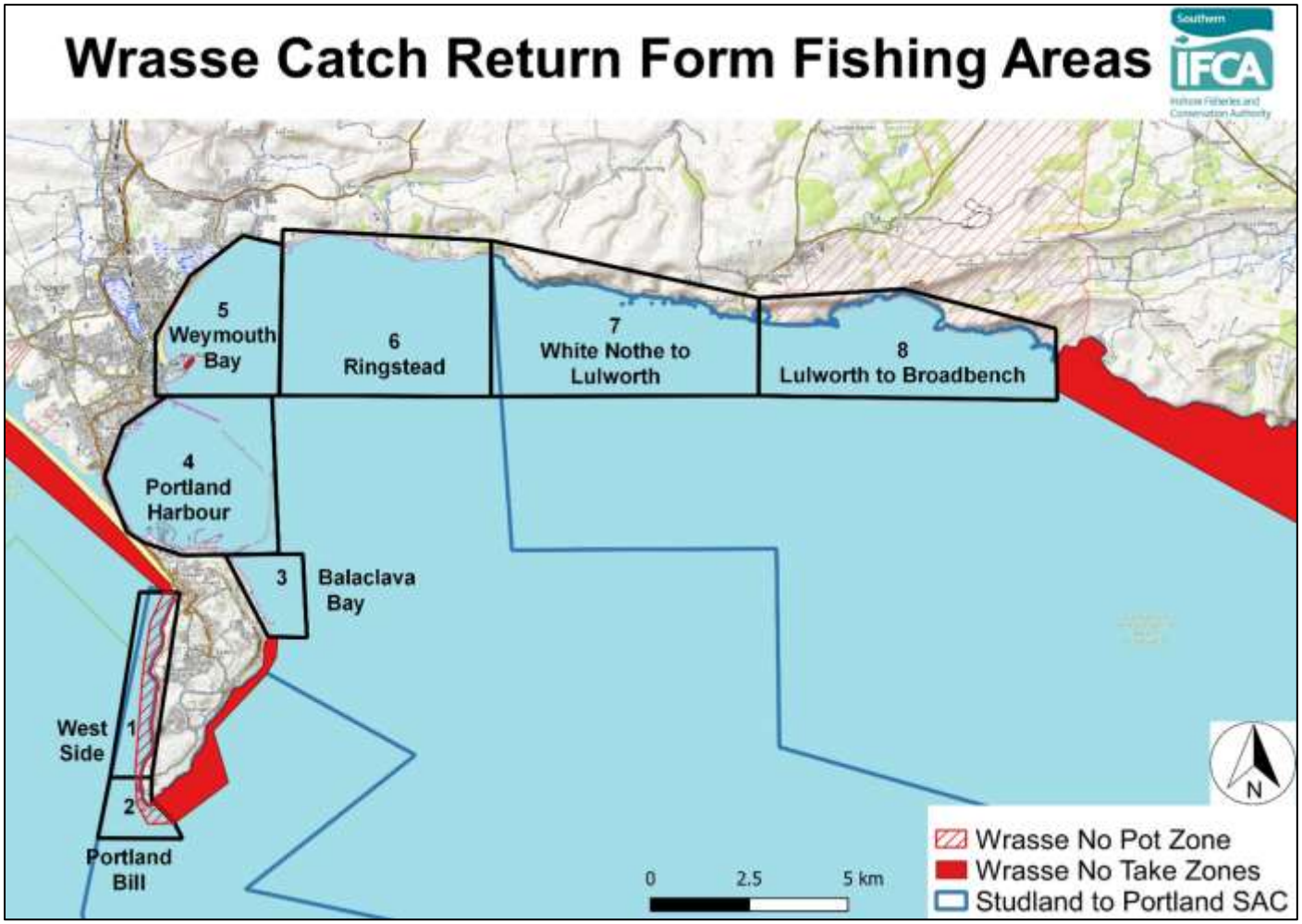

Figure 2. Live wrasse fishing areas in the Southern IFCA district including no take zones and no pot zone.

2.2 Data analysis

All data analysis and plotting was completed using the software package 'R'[1], version 4.0.2 (R Core Team, 2020).

2.2.1 Total fishery landings

Total landings for the fishery have been calculated using information on numbers of fish counted in lorries upon arrival at farms provided by the buyers of live wrasse.

2.2.2 Catch Return Form Submissions

In 2018, thirty-four catch return forms were received from fishery participants, and in 2019 thirty-seven CRFs were submitted.

Before the start of the 2020 wrasse fishery season, fishers were asked to submit monthly wrasse catch return forms (CRFs) by the 14th day of the following month. By the end of the 2020 fishing season, the nine fisheries participants had voluntarily submitted, thirty-three catch return forms. These covered the months July, August, September, October and November. In addition, fishers informed officers that a further nine catch returns were to be deemed as 'Nil returns' due to fishers not taking part in the fishery during that month, mostly November.

2.2.3 Landings Per Unit Effort

Landings per Unit Effort (LPUE) was calculated using data from fisher's catch return forms and represent the fish caught that were between the minimum and maximum conservation reference sizes.

Data were separated by fishing method ('pots' and 'rod and line') as the two fishing methods are very different and require a different LPUE calculation; hereafter referred to as $LPUE_{pot}$ and $LPUE_{rod}$. It is important to note however, that often rod and line fishing occurs on the same fishing trips (day) as pot fishing. As catch return forms require fishers to count the number of ballan wrasse, but do not require other wrasse species to be counted separately analysis has been undertaken on 'ballan wrasse', and 'mixed species' landings as well as 'total wrasse' landings. It is important to note that ballan wrasse are often caught whilst targeting mixed species, and similarly mixed species may be caught whilst targeting ballan wrasse.

Before calculating $LPUE_{pot}$, Generalised Linear Models (GLMs) were used to determine the variable(s) (number of pots and/or soak time) that should be used for the calculation of 'effort'. It was determined that pot soak time did not significantly affect landings of either ballan or mixed species, so soak time was not used in the calculation of 'effort' (see Annex 3 for results of this analysis). For each fishing trip $LPUE_{pot}$ was calculated as:

$LPUE_{pot}$ = Number of wrasse / Number of pots.

Both number of rods and number of hours fished were used to calculate $LPUE_{rod}$:

$LPUE_{rod}$ = Number of wrasse / (number of rods * number of hours fished)

Once $LPUE_{pot}$ and $LPUE_{rod}$ had been calculated, Generalised Linear Models were used to consider which variables (Year, Day of Year or Area Fished) best described the variation in the LPUE of ballan wrasse and mixed species. Gamma error structure with identity link function, within the generalised linear models were used to model LPUE. Fishing vessel was not included as a variable within the models as early analysis indicated that Vessel and Area fished explained similar portions of the variance in the data. This is likely due to vessels preferring to fish in the same area throughout the season and in consecutive seasons. The use of GLMs in this way permits the assessments of whether changes in LPUE have occurred over the 2018-2020 period, whilst accounting for changes between years that may be due to spatial and/or seasonal variation. Specific details of this method and model assessments are presented in Annex 4. All possible combinations

[1] https://www.r-project.org/

of variables were considered as input for the models, and the most parsimonious model was selected from the resulting list of candidate models.

Bar and line plots were created to show predicted variation between years and areas fished, as well as throughout the season (day of year). 95% confidence intervals have been used as a measure of variability about the mean predicted effect.

3 Results

3.1 Total number of fish landed

Table 1 summarises the numbers of wrasse bought by salmon farms from the Southern IFCA District in 2018, 2019 and 2020. Due to minor errors made in previous year's tallies the numbers reported here are slightly different to previously reported figures.

Between 2018 and 2019 there was a 29% increase in the number of live wrasses removed from the Southern IFCA fishery. Following recommendations made by the Southern IFCA Authority, IFCOs met with and discussed the increase with wrasse fishery buyers in order to ensure that totals removed in 2020 returned to levels similar to that removed in 2018. In 2020, 34,299 wrasses were removed from the fishery. This is a decrease of 19% from the 2019 total and a 4.5% increase from the 2018 baseline.

Table 1. The total number of live wrasses removed from the Southern IFCA District each year.

2018	**2019**	**2020**
32,825	42,295	34,299

3.2 Fishing Effort

3.2.1 Number of active vessels

In 2018, the wrasse fishery had approximately nine active vessels. This increased in 2019 to eleven due to a higher demand from wrasse buyers. However, Southern IFCA, through discussions with buyers, returned the total number of participants to nine in 2020 to reflect the requirements of the Monitoring and Control Plan.

3.2.2 Fishing trips

There has been some variability in the quality of data since 2017, which has been addressed by working with the fishers to amend the CRF structure. The analysis of the available suitable catch returns data can be used to determine trends in landings over time and therefore provide a basis for inferring sustainability of the fishery at the current effort. It should be noted, that large quantities of data could not be used for analysis (particularly in 2018 and 2019) due to unreliability and therefore this data should be interpreted with caution. For example, where a wrasse catch return only reported weekly landings numbers, or described total landings for two methods used on the same day, this data was excluded from analysis. Officers have worked with fishers to rectify these reporting errors.

Total reported fishing effort (days) using pots has remained fairly consistent over the past three years (Table 2). Small changes have occurred between areas, with higher fishing effort seen in Balaclava Bay and Portland Harbour/Weymouth Bay in 2020, and a reduction in Ringstead Bay. This can be explained by the changes in quantities of fish required by different wrasse buyers, as individual fishers supply particular buyers. It is apparent that relatively little pot wrasse fishing is occurring in the Studland to Portland SAC when compared to the surrounding areas.

In contrast, total reported fishing effort using rod and line increased in 2019. However, in 2020 only a small number of rod and line trips were carried out due to a change in wrasse fishery demand, with a larger requirement for other wrasse species replacing previously high demand for ballan wrasse (Table 2).

Table 2. Number of pot and rod and line fishing trips per area fished for each year, used in the analysis of Landings Per Unit Effort for the Southern IFCA wrasse fishery. (SAC) indicates the area's location is within the Studland to Portland SAC. NPZ = No potting zone.

Year	Area Fished								Total
	West Side (SAC)	**Portland Bill (SAC)**	**Balaclava Bay**	**Portland Harbour**	**Weymouth Bay**	**Ringstead Bay**	**White Nothe to Lulworth (SAC)**	**Lulworth to Broadbench (SAC)**	
Pot fishing									
2019	NPZ	NPZ	60	84		97	7	5	248
2020	NPZ	NPZ	89[2]	115[3]		60	36	0	300
Rod and line fishing									
2019	40	160	1	0	15	68	0	0	284
2020	0	25	0	0	0	9	0	0	34

3.2.3 Pot haul and rod hours totals

Similarly using the data suitable for LPUE analysis, the total pot hauls per year and rod hours fished were calculated (Figure 3). The figures highlight the shift in fishing method, to a rod and line dominated fishery in 2019, with a switch back to a pot fishery in 2020.

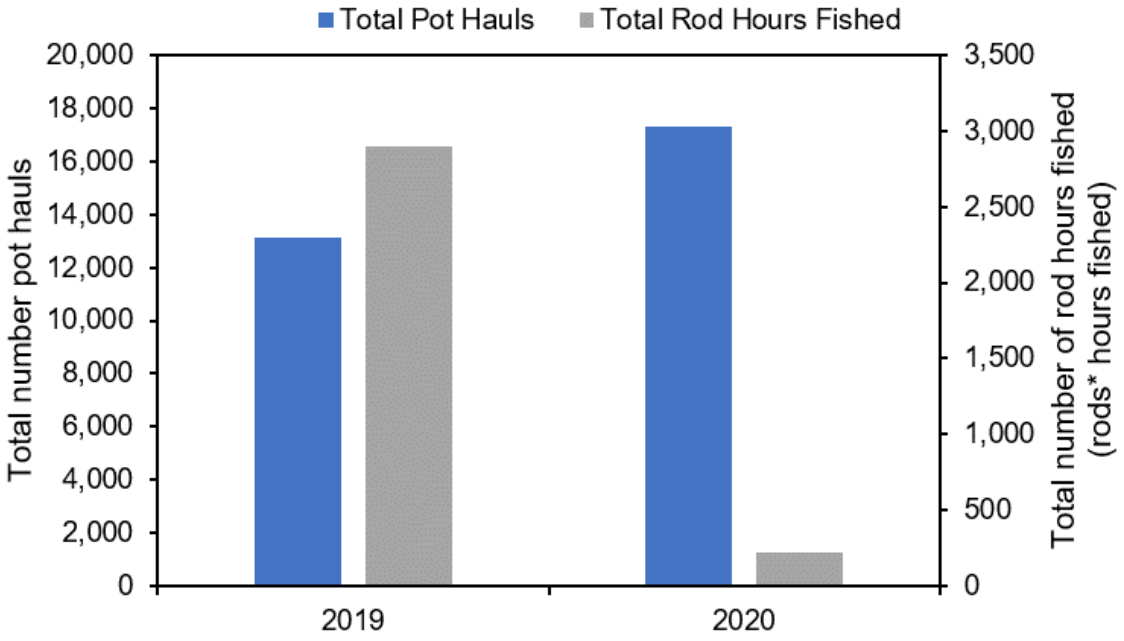

Figure 3. Total pot hauls and total rod hours fished of the Southern IFCA live wrasse fishery in the wrasse fishing seasons of 2019 and 2020. Note the separate axis for different fishing methods.

Wrasse fishing in 2020 occurred mainly outside of the Studland to Portland SAC, focused mostly in Portland Harbour/Weymouth Bay (two areas area combined on the map below) and Balaclava Bay (Figure 4 and Table 3).

[2] Catch return forms from September and October 2020 were not received from a fisher which fishes in this area.

[3] Catch return forms from September and October 2020 were not received from a fisher which fishes in this area.

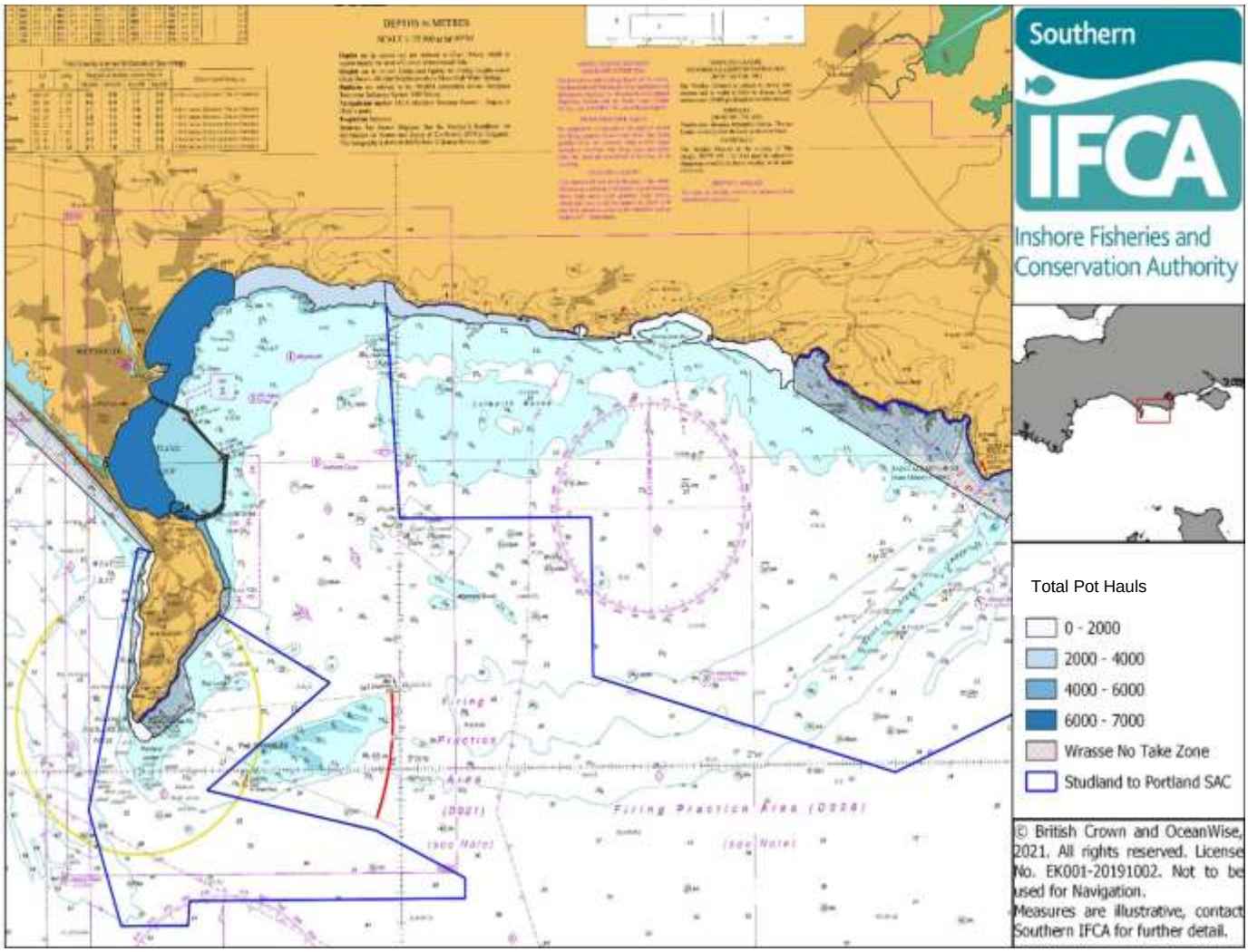

Figure 4. The total number of pots hauled in 2020 Southern IFCA wrasse fishery areas, inside and outside the Studland to Portland SAC. Portland Harbour and Weymouth Bay displayed as one area due to data limitations. For figures see *Table 3*.

Areas displayed out to the 10m contour in alignment with the Southern IFCA 'Wrasse Fishery Guidance' measures. Fishing may occur in deeper waters.

Table 3. The total number of pots hauled in 2020 Southern IFCA wrasse fishery areas, inside and outside the Studland to Portland SAC. Portland Harbour and Weymouth Bay displayed as one area due to data limitations.

***West Side** (SAC)*	***Portland Bill** (SAC)*	***Balaclava Bay***	***Portland Harbour / Weymouth Bay***	***Ringstead***	***White Nothe to Lulworth** (SAC)*	***Lulworth to Broadbench** (SAC)*
0	*0*	*5520*	*6730*	*2542*	*2520*	*0*

3.3 Landings per Unit Effort

3.3.1 Total pot caught wrasses

Due to data limitations, areas 4 & 5 (Portland Harbour and Weymouth Bay) had to be combined for this analysis. In the figures below this combined data sits under the label area '4'.

No significant difference in total $LPUE_{pot}$ was found between years.

However, total $LPUE_{pot}$ varied significantly across fishing areas (Figure 5 and Annex 5: Table 7). Post-hoc Tukey tests indicated that Portland Harbour/Weymouth Bay (Area 4) had a higher $LPUE_{pot}$ than Balaclava Bay (Area 6), and Ringstead Bay (Area 3)

There was also evidence of some seasonal variation in total $LPUE_{pot}$, where $LPUE_{pot}$ decreased from the end of August onwards (Figure 5).

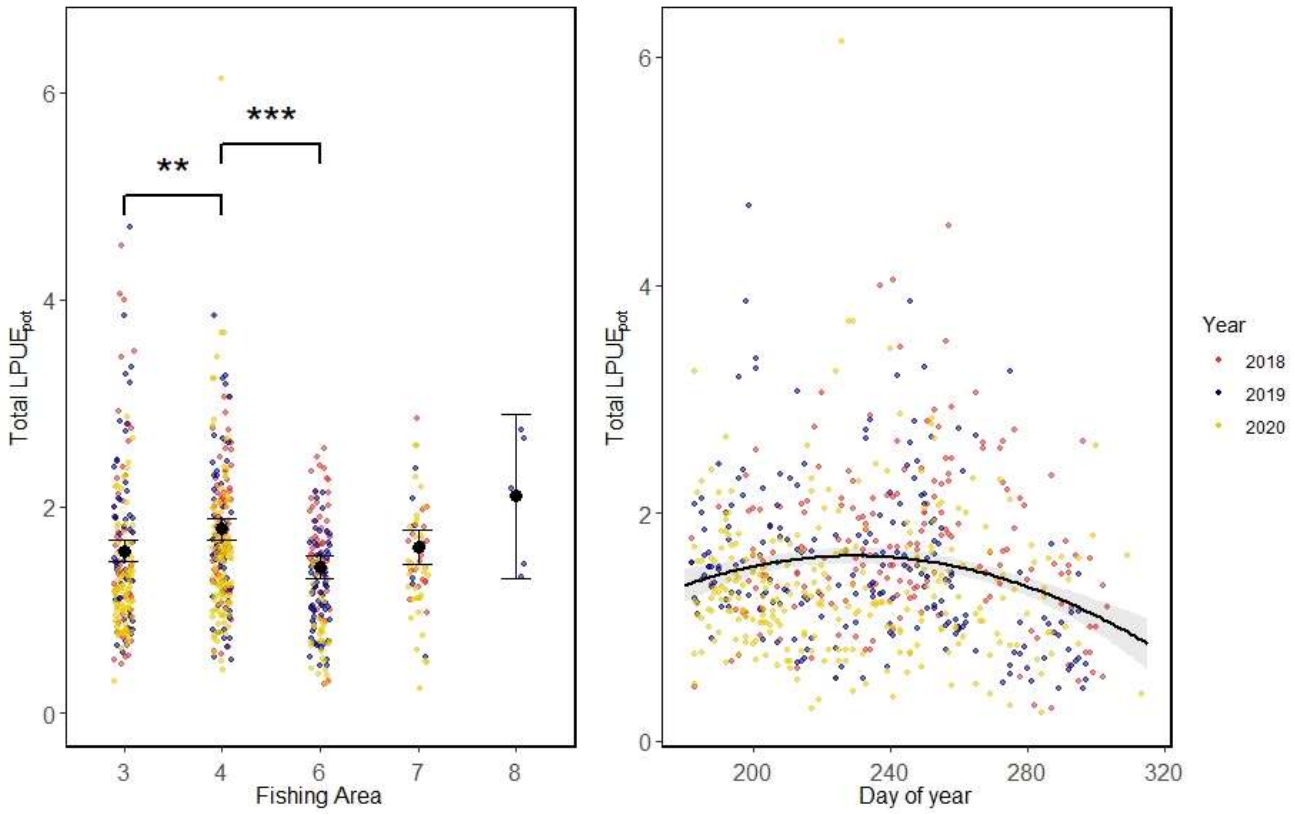

Figure 5. Predicted effects (mean) of fishing area (left) and year (right) on Landings Per Unit Effort (pot) of total wrasses caught in the Southern IFCA District. Error bars/grey shading show 95% confidence intervals around the predicted means as estimated by the Generalised Linear Models. ** and *** denotes <0.01 and <0.001 significance respectively.

Area codes: 3: Balaclava Bay, 4: Portland Harbour/ Weymouth Bay, 6: Ringstead Bay, 7: White Nothe to Lulworth, 8: Lulworth to Broadbench.

3.3.2 Pot caught ballan wrasse

Ballan $LPUE_{pot}$ was calculated using only the data from trips where mixed species were targeted. The number of trips in which fishers targeted only ballan wrasse with pots has decreased year on year since 2018. This is due to a shift to rod and line fishing in 2019, followed by a reduction in demand for ballan wrasse in 2020.

Due to data limitations, areas 4 & 5 (Portland Harbour and Weymouth Bay) had to be combined for this analysis. In the figures below this combined data sits under the label area '4'.

Ballan $LPUE_{pot}$ varied significantly across years (Figure 6), with significantly higher landings in 2020 than in both 2018 and 2019 (Annex 5: Table 8).

There was also significant spatial variation on ballan $LPUE_{pot}$ (Figure 6): landings in Ringstead Bay (Area 6) were significantly lower than all area's except Lulworth to Broadbench (Area 8) and Ballan $LPUE_{pot}$ in Portland Harbour/ Weymouth Bay (Area 4) was significantly higher than all areas except Balaclava Bay (Area 3). It must be noted that only a small amount of data from 2019 was available for Lulworth to Broadbench.

Ballan $LPUE_{pot}$ varied seasonally, increasing throughout the season, however, this was only a small effect.

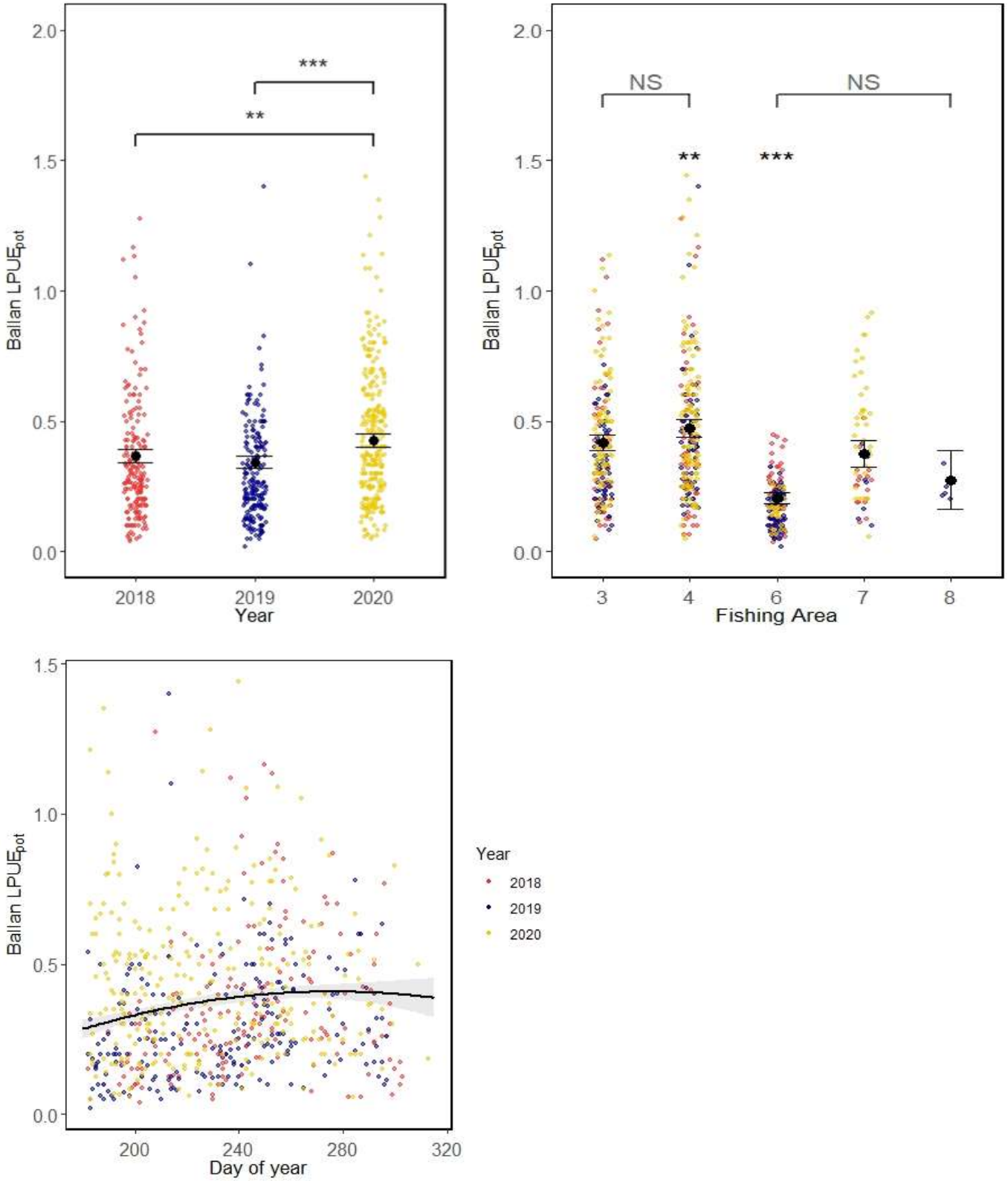

Figure 6. Predicted effects (mean) of fishing area (left), year (right) and Day of Year (bellow) on Landings Per Unit Effort (pot) of Ballan wrasses caught in the Southern IFCA District (trips which target both Ballan & mixed wrasse). Error bars/grey shading show 95% confidence intervals around the predicted means as estimated by the Generalised Linear Models. ** and *** denotes <0.01 and <0.001 significance respectively. NS = Not significant pairing.

Area codes: 3: Balaclava Bay, 4: Portland Harbour/Weymouth Bay, 6: Ringstead Bay, 7: White Nothe to Lulworth and 8: Lulworth to Broadbench.

3.3.3 Mixed pot caught wrasse

Due to data limitations, areas 4 & 5 (Portland Harbour and Weymouth Bay) had to be combined for this analysis. In the figures below this combined data sits under the label area '4'.

Mixed wrasse $LPUE_{pot}$ decreased significantly across all years (Figure 7 and Annex 5: Table 9). The largest decline is seen between 2019 and 2020. In 2020, wrasse buyers only required corkwing and goldsinny species, and therefore rock cook and baillon's may have been caught, but returned to sea, and therefore not recorded on wrasse catch returns or buyer numbers.

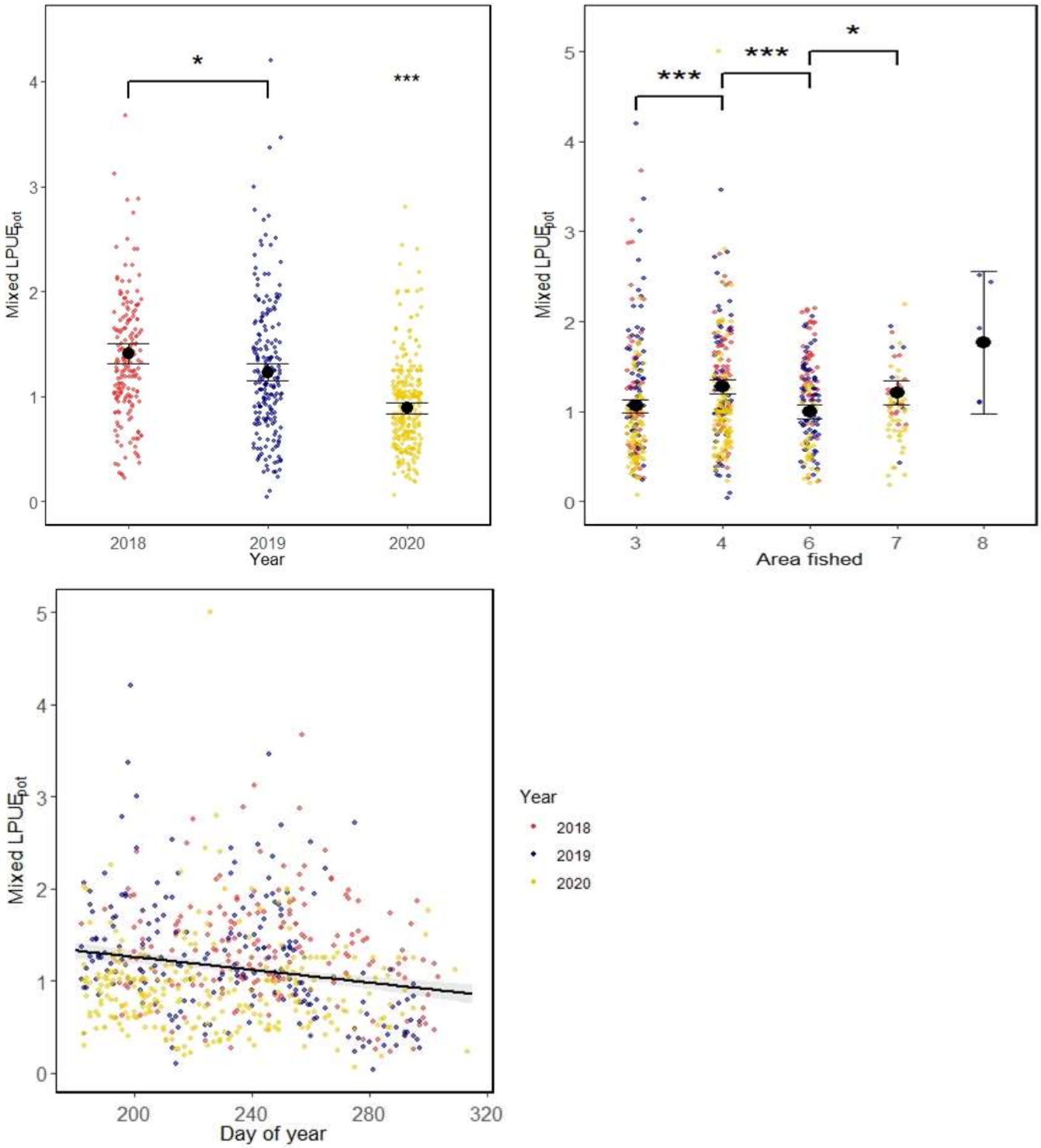

Figure 7. Predicted effects (mean) of year (left), fishing area (right) and Day of Year (below) on Landings Per Unit Effort (pot) of mixed wrasses caught in the Southern IFCA District. Error bars/grey shading show 95% confidence intervals around the predicted means as estimated by the Generalised Linear Models. *, ** and *** denotes <0.05, <0.01 and <0.001 significance respectively.

Area codes: 3: Balaclava Bay, 4: Portland Harbour & Weymouth Bay, 6: Ringstead Bay, 7: White Nothe to Lulworth and 8: Lulworth to Broadbench.

There was significant variation in mixed $LPUE_{pot}$ between areas fished. Post-hoc Tukey tests revealed that Portland Harbour/Weymouth Bay (Area 4) has a higher mixed $LPUE_{pot}$ than both Balaclava Bay (Area 3) and Ringstead Bay (Area 6). Ringstead Bay $LPUE_{pot}$ was also significantly lower than that of White Nothe to Lulworth (Area 7).

Mixed $LPUE_{pot}$ also showed a negative linear effect of Day of Year across the fishing season.

3.3.4 Ballan rod and line caught wrasse

As a result of the limited number of ballan rod and line fishing trips in 2020, no models were able to be fitted over the 2018–2020 period. For note, the fishery reverted back to potting fishing as the main method of wrasse collection, in 2020. Therefore, analysis of 2018 and 2019 data was completed separately.

Ballan $LPUE_{rod}$ varied across both year and fishing area (Figure 8 and Annex 5: Table 10). Ballan $LPUE_{rod}$ was significantly higher in 2019 than 2018 (Figure 8). Ballan $LPUE_{rod}$ was highest in Portland Bill (Area 2), and lowest in Balaclava Bay and Ringstead Bay (Areas 3 and 6). There was very limited data from Portland Harbour (Area 4) and White Nothe to Lulworth (Area 7).

There was no seasonal variation in ballan rod and line landings.

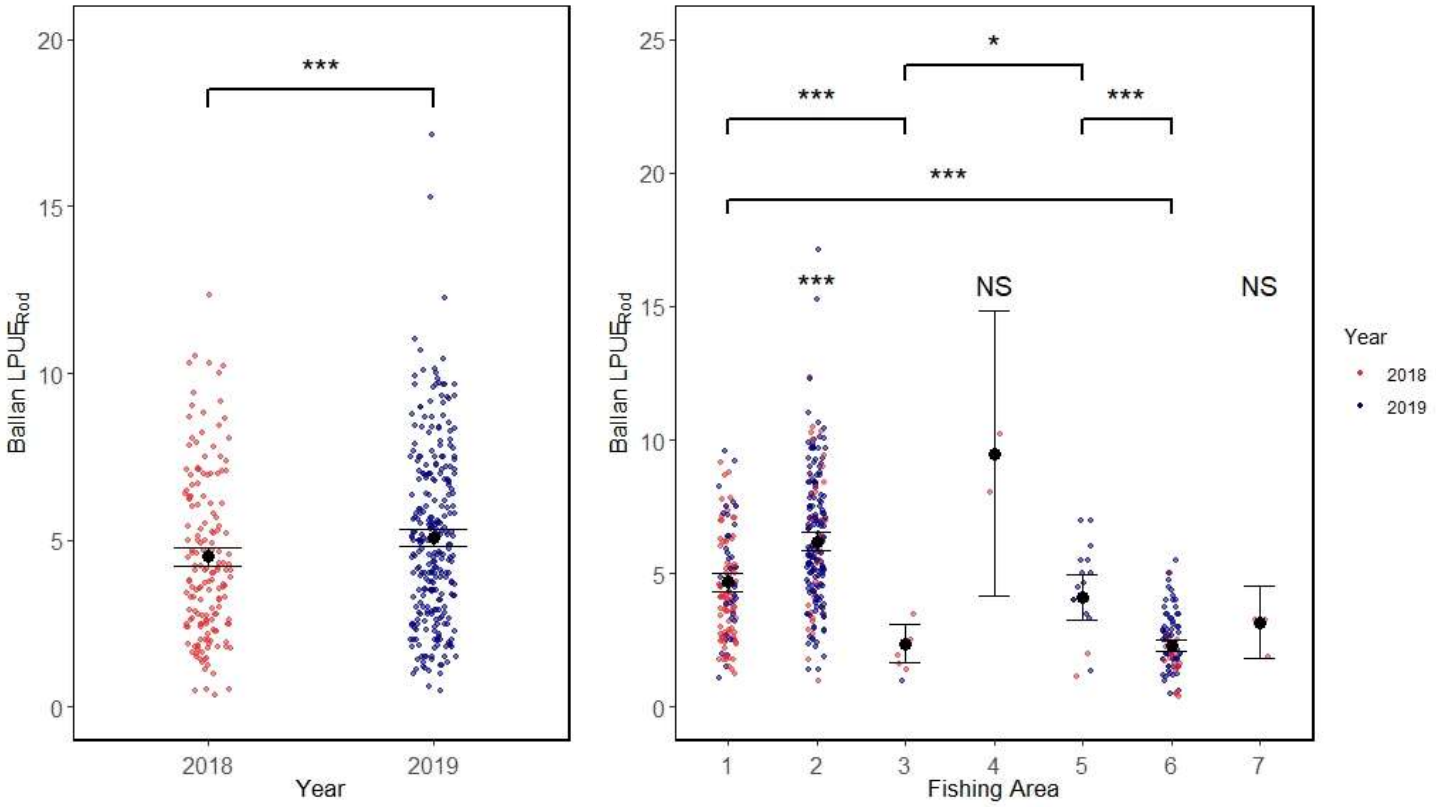

Figure 8. Predicted effects (mean) of year (left) and fishing area (right) on Landings Per Unit Effort (rod) of ballan wrasse caught in the Southern IFCA District. Error bars show 95% confidence intervals around the predicted means as estimated by the Generalised Linear Models. * and *** denotes <0.05 and <0.001 significance respectively. NS, denotes Non-significant data.

Area codes: 1: West Side, 2: Portland Bill, 3: Balaclava Bay, 4: Portland Harbour, 5: Weymouth Bay, 6: Ringstead Bay and 7: White Nothe to Lulworth.

3.3.5 Comparisons of GLMs for wrasse LPUE based on AIC

This section reports comparisons (based on AIC) of the GLMs for the response variable (LPUE) for total wrasse (TW), mixed wrasses (MW), ballan wrasse from mixed wrasse fishing trips (BW^{m}) and ballan wrasse from ballan only fishing trips (BW^{b}). Ballan wrasse from Rod and line fishing trips are also reported (BW). In all cases, both the 'test' GLM and the 'null' GLM are reported for comparison.

Table 4. Summary of AIC analysis of all GLMs (gamma error structure) used to assess Landings Per Unit Effort (from pots; $LPUE_{pot}$). ' • ' indicates the presence of each predictor in the model, LL is the log-likelihood of the model, k is the number of parameters, and AIC denotes the AIC value of the model. The null model is denoted 'null', and the most parsimonious model for each dataset is denoted '$_{test}$'. TW = total wrasse, MW = mixed wrasse, BW = ballan wrasse. [m] wrasse from trips which target both ballan and mixed wrasse. [b] Ballan wrasse from trips which target only ballan wrasse.

Model	Model Parameters				LL	*k*	AIC
	Intercept	Day of Year	Area Fished	Year			
Pot fishing							
TW $_{test}$	●	●	●		-591.3367	8	1198.673
TW $_{null}$	●				-624.3283	2	1252.657
MW $_{test}$	●	●	●	●	-472.1348	9	962.27
MW $_{null}$	●				-530.2035	2	1064.4
BW^{m} $_{test}$	●	●	●	●	268.0448	10	-516.0896
BW^{m} $_{null}$	●				114.5306	2	-225.0612
Rod and line fishing							
BW $_{test}$	●		●	●	-912.955	9	1843.9
BW $_{null}$	●				-1031.314	2	2066.6

4 Discussion

4.1 Fishing effort

Analysis of data in this report has clearly shown that the live wrasse fishery is continuing to change and adapt with each season. In 2019 the fishery targeted mostly ballan wrasse using rod and line as the main capture method. However, in 2020 wrasse buyers required lower levels of ballan wrasse, leading to a mainly pot dominated fishery. In 2020, nearly all catch return forms were received, giving good confidence in the fishing effort data. As this analysis was based only on that data which was suitable for LPUE, statistical analysis has not been completed on fishing effort. This is to avoid coming to statistical conclusions from an incomplete dataset.

Monitoring the effort of fishing within given areas is particularly important for the live wrasse fishery due to its location in and around the Studland to Portland SAC, designated for its rocky reefs which in turn support the target wrasse species. Over the two years fishing effort within the east side of the SAC has been low. However, in 2019 fishing effort of off the Isle of Portland in the west side of the SAC spiked, with this area proving popular for rod and line fishing. In 2020, the vast majority of wrasse fishing occurred outside of the SAC, between Balaclava Bay and Ringstead Bay.

4.2 Trends in LPUE and Indications of Sustainability

All three variables (Year, Area Fished and Day of Year) tested in this analysis gave rise to significant effects on the LPUE of wrasses caught in the Southern IFCA Live wrasse Fishery. The most prolific, proving important in all analysis was Area Fished. Year proved to have an effect on all data except when it was pooled into 'total wrasse per pot'. On the other hand, day of year (seasonality) effects were found only in data collected on pot fishing trips.

4.2.1 Year

The high-level analysis of Southern IFCA's wrasse fishery Landings Per Unit Effort do not suggest that the fishery as a whole is fishing local wrasse stock unsustainably.

However, pooled 'total wrasse LPUE' may mask species-specific trends. When data was broken down into wrasse groups 'ballan wrasse' and 'mixed wrasse' the two groups indicate different trends. The gradual and significant decline in LPUE of mixed wrasses from 2018 to 2019, as well as 2019 to 2020 suggests that the mixed wrasse species stocks may have started to become depleted in the 2019 fishing season. However, due to the short time scale of the study it is not possible to rule out natural variation in fish landings across years or that landings may depend on a number of factors including climactic and environmental conditions.

However, in 2020, only two of the previous four wrasse species were targeted; goldsinny and corkwing wrasse. As only LPUE data (i.e. not counting fish that were returned to the sea) are available, we would

expect a significant decrease in LPUE to be seen between the 2018-2020 period as only two of the four species were being retained. This change in fishing practise highlights the need to collect species-specific data in order to determine the effects of the fishery on wrasse fishing sustainability. More detailed research on LPUE and Catch Per Unit Effort (CPUE) in the Plymouth Sound Fishery, found species-specific effects of the removal of wrasses (Henly et al., in review; Curtin Henly & Stewart, 2020).

In contrast, ballan wrasse have shown an overall increase in LPUE across years. LPUE of ballan wrasse from pots in 2020 was higher than both 2018 and 2019. This could be due to a number of reasons. First, natural variation in fish landings across years is highly likely and may depend on a number of factors including climactic and environmental conditions. It was not possible to collect environmental data to standardise LPUE in this study, however we were able to control for broad-scale fishing areas (see section 4.2.2.). Second, ballan wrasse populations may be showing signs of recovering from 2018 and earlier, where ballan wrasse were more targeted. Finally, this specific year effect could be due to a lower demand for rod and line caught ballan wrasse in 2020 which is may have led to increases of catch within pots, due to a larger proportion of the stock being available to this fishery.

Similarly, ballan wrasse collected using rod and line increased in LPUE between 2018 and 2019. Whilst this may also be a result of varying environmental conditions such as longer periods of calm weather seen in 2019 (pers. obs.), it may also be as a result of improved fishing methods developed throughout the 2018 season. For example, fishers may have gained detailed knowledge of fishing areas and specifically selected areas within the broad scale areas considered in this analysis that yielded higher landings. Fishers may have also began using a more successful bait or hook, increasing the likelihood of catching ballan wrasse using rod and line.

4.2.2 Area Fished

Area fished has proven to be the most reliable factor predicting variation in LPUE of both pot caught and rod and line caught wrasse. Trends in all pot fishing analysis suggest that the area Portland Harbour/ Weymouth Bay gives rise to the highest LPUE, whilst Ringstead Bay typically has a lower LPUE than this and other areas. Henly, *et al.,* (in review) found that both CPUE and LPUE of all wrasse species (with the exception of corkwing wrasse) varied across broad-scale fishing areas in Plymouth Sound. The current analysis confirms the importance of standardising LPUE across fishing areas that may experience largely different environmental conditions. For example, the Portland harbour and Weymouth Bay are likely to be the most sheltered areas of the Southern IFCA fishery protected from prevailing south westerly weather. Ringstead Bay is likely to be more exposed to severe weather which may lead to its lower LPUE. Portland Bill is likely to experience much greater changes in currents than other areas, which may be an important factor influencing the number and size of fish available to catch.

No data on LPUE of pot fishing has been collected around the Isle of Portland as these areas are ‘no pot and no take zones’. However, rod and line fishing is possible on the west side of Portland and at the Bill. Analysis of rod and line LPUE showed that catches of ballan wrasse in this area are highest throughout the fishery. A lack of effort in this area particularly regarding pot fishing may have enabled stock levels to remain high. However, it is also possible that the habitat, and exposure levels are more suited to the larger ballan wrasse that are generally targeted by the fishery, and that this area supports larger stocks than those such as Portland Harbour and Weymouth Bay.

4.2.3 Seasonality (Day of year)

Seasonal effects on the Southern IFCA wrasse fishery are evident however, trends differ between the groups. The trend for total wrasse suggests that LPUE rises from around July to August, before beginning to declining from the end of August onwards. Ballan wrasse, along with rock cook and corkwing wrasse, build and guard nests following spawning (Costello *et al*., 1991; Hillden, 1981; Darwall *et al*., 1992). If the wrasse spawning season were to end around June/ July in the SIFCA district, then the slight increase in LPUE seen around August may be as a result of wrasse becoming more active, and hence more catchable, once they have finished guarding their egg nests (Darwell *et al.,* 1992).

However, this analysis of total LPUE masks more group specific effects. Ballan wrasse catchability appears to increase throughout the season. As suggested above it is likely that Ballan wrasse become less active

during their spawning season from April to August (Darwell *et al.,* 1992), and as more fish complete the mating and spawning stage of their life cycle, they become easier to catch in the later part of the wrasse fishing season.

Meanwhile, mixed wrasse landings decline throughout the season. At first glance when considered along with the 2019 decline in mixed wrasse LPUE, this could be a sign that mixed wrasses are not being harvested at sustainable levels. However, due to changes within the fishery where only two of the four wrasse species were targeted in 2020, it is not possible to be certain. The decline could be attributed to a reduction in the stock; however, it may also be a factor of seasonal changes in environmental conditions and wrasse behaviour. The fishery commences at the height of summer (July and August), when periods of warm and calm weather are most frequent. The fishery continues into Autumn (September and October), as temperatures fall and periods of increased wind become more regular, reducing the number of days fishers can fish. As this group represents four different wrasse species the exact effects of seasonality, environmental conditions and sustainability are hard to interpret. Some research has found that presence of goldsinny, corkwing and rock cook wrasses is associated with season and temperature, where by lower catches are observed in late autumn and winter, followed by increasing catches in spring and summer (Sayer *et al.,* 2005; Thangsted, 1999; Darwall *et al.,* 1992).

4.3 Data Limitations and Future Data Collection

The data used in this analysis of Landing's Per Unit Effort in the Southern IFCA wrasse fishery has been submitted voluntarily over the past three years by fishers. Earlier on in the period the data collection method gave rise to some data that could not be used for LPUE analysis. However, this has improved year on year with changes to data collection forms and ways of working with fishers. In order to further improve the quality and level of data submitted and enable species-level analysis, for the 2021 season the Authority will introduce, under the 'Fishery Guidance Measures' a monthly reporting deadline, together with a requirement for species-level, rather than aggregated data.

Over the past three-years fishers have been required to submit number of 'ballan wrasse' separated from numbers of 'mixed wrasses'. This was implemented due to the knowledge that ballan wrasse were the main target of the fishery, and understanding that fishers were not confidently able to distinguish between the other four wrasse species. In 2019, demand for ballan wrasse increased, however in the following year, demand for ballan wrasse subsided and there was an increased demand for corkwing and goldsinny wrasses. The Southern IFCA wrasse fishery has not yet settled, and it is for this reason, in order to understand it's true effects, that data collection going forward, should be specific to individual wrasse species. This will ensure that as the fishery continues, management of the fishery can react to effects at the species-specific level like those seen in Plymouth Sound (Curtin, Henly & Stewart, 2020; Henly et al., in review).

Data collected in the Southern IFCA wrasse fishery currently considers only those fish which fall between the minimum and maximum conservation reference sizes. Southern IFCA successfully monitored Catch Per Unit Effort (CPUE) in 2017, however in the subsequent years due to an increase in workloads regarding new tranche three Marine Conservation Zones, resources have not been available to continue this monitoring. If possible, a continuation of this collaborative research will provide valuable information about bycatch and enable further analysis of younger wrasse cohorts and the sex-ratios of the wrasse species.

5 Conclusion

The analysis of Southern IFCA's wrasse fishery data has not found any significant suggestion that the fishery is operating at an unsustainable level. Landings per unit effort of total pot caught wrasse has not changed significantly other the three-year timescale, whilst landings of ballan wrasse caught in pots increased in 2020, and ballan wrasse using rod and line increased from 2018 to 2019. However, the analysis of mixed wrasse found a significant decline between 2018 and 2019. As this analysis was not able to control for environmental variables it is not possible to be certain that this decline occurred due to fishing pressure. The uncertainty associated with the mixed wrasse landings recorded in 2020, where two species were not retained and reported on, limits the ability to draw further conclusions on the status of 'mixed wrasse' stocks. This result

should therefore be interpreted with caution. In order to monitor whether this decline is a continuing trend, Southern IFCA will monitor LPUE of individual wrasse species throughout the 2021 season.

Data collection within the fishery has improved year on year, with a higher percentage of voluntary CRFs received including more accurate data. However, future data collection should be required at the species-specific level in order to monitor effects between target species. In addition, submission of CRFs by a specified date will aid the analysis of the wrasse fishery on an annual basis. Furthermore, when possible, given the availability of resources and relaxation of social restrictions, monitoring of changes in CPUE of all fish sizes should be completed annually to ensure effects on wrasse stocks are not being masked by the interpretation of data pertaining only to those fish sizes which are within the minimum and maximum conservation reference sizes.

6 References

Bennet L. R Hawkins. 2017. Loch Duart Ltd Cleaner Fish Co-ordinator. Personal communications during 2017.

Bjordal A. 1988. Cleaning symbiosis between wrasse (Labridae) and lice infested salmon (*Salmo salar*) in mariculture. International Council for the Exploration of the Sea, Mariculture Committee 188/F 17. 8 pages.

Costello, M.J. 1991. Review of the biology (Labridae: Pisces) in Northern Europe. *Prog. Underwater. Sci*., 16, 29-51.

Curtin, S., Henly, L. and Stewart, J. (2020) Three Year Comprehensive Review of the Live Wrasse Fishery in Devon & Severn IFCA's District. Devon & Severn Inshore Fisheries and Conservation Authority, Brixham Laboratories, Brixham, Devon.

Darwall, W. R. T., Costello, M. J., Donnelly, R., and Lysaght, S. 1992. Implications of life-history strategies for a new wrasse fishery. *J. Fish Biol.*, 41: 111–123

Henly, L, Stewart, J., and Simpson, S. (in review) Drivers and Implications of change in an inshore multi-species fishery.

Hillden, N. 1981. Territoriality and reproductive behaviour in the goldsinny, *Ctenolabrus rupestris* L. *Behav. Process*., 6, 207-221

Sayer, M.D., Gibson, R. N., Atkinson, R.J.A. 2005. Distribution and density of populations of Goldsinny wrasse *(Ctenolabrus rupestris)* on the west coast of Scotland. Journal of Fish Biology. **43:** 157-167. DOI: 10.1111/j.1095-8649.1993.tb01185.x

Thangsted, T. 1999. Spatial and temporal distribution of three wrasse species (Pisce: Labridae) in Masfjord, Western Norway: habitat association and effects of environmental variables. Thesis. Department of Fisheries and Marine Biology. University of Bergen.

Annex 1. Catch Return Forms 2018 and 2019/2020

Live Wrasse Fishery – Monthly Catch Return Form 2018										
Vessel name:		**PLN:**	**Home port:**	**Month:**						
Date	**Number of pots hauled**	**Number of rods used (hours fished)**	**Fishing Area(s) *See catch return area map**	**Number of fish retained**						
				Ballan	**Corkwing**	**Goldsinny**	**Rock cook**	**Baillon's**		
1										
2										
3										
…										

Live Wrasse Fishery – Monthly Catch Return Form 2019 & 2020									
Vessel Name:		**PLN:**		**Home Port:**		**Month:**			
Date	**Area Fished (*See catch return map)**	**No. of pots**	**No. hours soaked**	**No. of POT fish retained**		**No. of Rods**	**No. of hours fished**	**No. of LINE fish retained**	
				Ballan wrasse	**Mixed wrasse**			**Ballan wrasse**	**Mixed wrasse**
1									
2									
3									
…									

Annex 2. Data limitations and solutions used during analysis

Data analysis was completed based upon Catch Return Forms (CRFs) completed by fishers themselves. Unfortunately, CRFs are sometimes received having been incorrectly completed or with missing information. Where possible missing information is sought from the fisher themselves. However, when it is not possible to retrieve this information the following solutions were used to reliably complete the data set. This was a particular issue in 2018, however, over 2019 and 2020 CRFs became substantially completed and more accurate.

Limitation	Solution
Missing trap soak time	Time calculated based on previous fishing trip date
Missing trap haul number/ number of rods	Estimated based on previous and following haul number/ rods used
Wrasse catches not reported daily	Data omitted from analysis
Missing line hours fished	Time estimated based on average of previous or following season daily hours fished

Annex 3. Details of Generalised Linear Model Outputs completed to determine the LPUE calculation for pot caught wrasse

Table 5. Summary of AIC analysis of all GLMs (gamma error structure) used to assess 'Total number of wrasse' (from X number of pots). '• ' indicates the presence of each predictor in the model, LL is the log-likelihood of the model, k is the number of parameters, and AIC denotes the AIC value of the model. The null model is denoted 'null', the two test models are denoted 'pots' & 'hours'. TW = total wrasse from trips which target both ballan and mixed wrasse.

Model	Model Parameters			LL	*k*	AIC
	Intercept	Number of pots	Hours Fished			
TW_{pots}	●	●		-1932.858	3	3871.716
TW_{hours}	●		●	-2007.856	3	4021.712
TW_{null}	●			-2010.373	2	4024.747

Table 6. Summary of GLM results testing for the main drivers of variation in total pot caught wrasse (ballan + mixed), showing model coefficients and their standard errors; $p < 0.05$, $p<0.01$ and $p < 0.001$, indicates significance (i.e. whether a continuous variable (no..of..pots) is a significant predictor of the variation in Total wrasse. This table shows the results of the model that is most parsimonious with respect to the data (see Annex 4 for full methods details and a summary of AIC analyses).

Coefficient	Parameter estimate	Standard error	*p*
Intercept	4.48438	0.02141	<0.001
Scale(no..of.pots)	0.29786	0.02147	<0.001

Annex 4. Methods of LPUE analyses using Generalised Linear models (Adapted from Curtin, Henly and Stewart, 2020).

Generalised Linear Models (GLMs) were used to assess changes in LPUE of pot and rod and line caught total, mixed and ballan wrasses. GLMS are a more flexible form of 'linear regression'. Linear regression is a statistical method that described change in the response (a variable) as a function of change in one or more predictors (factors). For this approach the response variable (LPUE) has to be normally distributed, and has a linear relationship with the predictors. However, the LPUE data analysed in this report did not have a normal distribution, instead it was a negative binomial error distribution. The GLM allows for the modelling of non-normal response variables and non-linear relationships between the response and the predictor. In this analysis GLMS with a gamma error structure were used because the gamma distribution is a good approximation for the LPUE data (when plotted the bell in the data is on the far left of the plot and not normal). To assess changes in LPUE over the 2018 to 2020 period, these GLMs were fitted with year and area fished as categorical predictors, and Day of Year and Day of Year squared as a continuous variable. This allows for the identification of changes in (for example) LPUE which occur between years, whilst accounting for changes that occur due to differences in the response variable between areas, or over the course of the fishing season.

Detailed modelling and model selection approach

For each response variable (LPUE for each species and CPUE for each species), two models were constructed: a 'test model' (including Year and vessel ID as predictors), and a null model (which contained no predictor variables). Comparing the test model to this null model essentially allows for assessment of whether the models are performing better than random (i.e. whether the predictor terms are useful in predicting the response variable). The 'test' and 'null' models were compared using an 'information theoretic approach', based on their Akaike's Information Criterion (AIC) value: the model having the lowest AIC is likely the most parsimonious. However, as AIC is only an estimate of parsimony, other models were also considered, in line with Richards (2008): any model within 6 AIC units of the model with the lowest AIC were deemed to perform equally well. Therefore, if the 'test' model for each response variable was within 6 AIC units of the corresponding null model, it was deemed to have failed to outperform the null, implying that the tested predictor variables are not associated with change in the response variable.

Biological inference based on selected models

Following selection of the most parsimonious model for each response variable, the GLM output was used to identify changes in the response variable over the 2018–2020 period. For cases in which a model outperforms the associated null model (based on AIC), this is widely considered to be sufficient evidence that the predictor variables are useful in predicting change in the response variable. However, *p*-values associated with individual model terms are presented, as these may be more familiar to readers of this report. *P*-values < 0.05 essentially indicate that the model terms are significant predictors of change in the response.

Model assessment

Model diagnostics were checked based on visual assessment of model residuals. Where model diagnostics were deemed to be unsatisfactory, alternative GLM error structures and link functions were attempted. These approaches are common and in widespread scientific use (see e.g. Crawley, 2007).

Effect plots and reporting

In order to report upon the significance between factor variable levels, Post-hoc Tukey testing was performed and used to understand which levels of a factor were significantly different from one another.

Literature Cited

Crawley, M.J. 2007. The R Book. John Wiley and Sons Ltd, Chichester, United Kingdom, 942 pp.

Richards, S.A. 2008. Dealing with over dispersed count data in applied ecology. *Journal of Applied Ecology*, 45: 218–227.

Annex 5. Details of Generalised Linear Model Outputs presented as results in this report.

Total Pot Caught Wrasses

Table 7. Summary of GLM results testing for the main drivers of variation in LPUE of total pot caught wrasse (ballan + mixed), showing model coefficients and their standard errors; p < 0.05, p<0.01 and p < 0.001, indicates significance (i.e. whether a continuous variable (DOY) is a significant predictor of the variation in LPUE, or if LPUE is significantly different relative to the mean of all other levels of a factor variable(Year/Area). This table shows the results of the model that is most parsimonious with respect to the data (see Annex 4 for full methods details and a summary of AIC analyses).

Coefficient	**Parameter estimate**	**Standard error**	***p***
Intercept	-0.384	0.128	<0.01
Doy	0.048	0.011	<0.001
I(DOY^2)	-0.0001	0.00002	<0.001
Balaclava Bay	-0.012	0.092	0.178
Portland Harbour & Weymouth bay	0.086	0.092	0.348
Ringstead bay	-0.279	0.091	<0.01
White Nothe to Lulworth	-0.088	0.106	0.407

Pot caught ballan wrasse from trips targeting both ballan and mixed wrasse

Table 8. Summary of GLM results testing for the main drivers of variation in LPUE of ballan pot caught wrasse (from trips targeting both ballan an mixed wrasse), showing model coefficients and their standard errors; p < 0.05, p<0.01 and p < 0.001, indicates significance (i.e. whether a continuous variable (DOY) is a significant predictor of the variation in LPUE, or if LPUE is significantly different relative to the mean of all other levels of a factor variable (Year/Area). This table shows the results of the model that is most parsimonious with respect to the data (see Annex 4 for full methods details and a summary of AIC analyses).

Coefficient	**Parameter estimate**	**Standard error**	***p***
Intercept	-0.6715	0.294	<0.05
Year2019	-0.024	0.015	0.100
Year2020	0.059	0.017	<0.001
DOY	0.007	0.003	<0.01

I(DOY^2)	-0.00001	0.000005	<0.05
Balaclava Bay	0.067	0.017	<0.001
Portland/ Weymouth bay	0.124	0.0182	<0.001
Ringstead	-0.142	0.0148	<0.001
White Nothe to Lulworth	0.025	0.025	0.303

Pot caught mixed wrasse

Table 9. Summary of GLM results testing for the main drivers of variation in LPUE of pot caught mixed wrasse, showing model coefficients and their standard errors; p < 0.05, p<0.01 and p < 0.001, indicates significance (i.e. whether a continuous variable (DOY) is a significant predictor of the variation in LPUE, or if LPUE is significantly different relative to the mean of all other levels of a factor variable (Year/Area)). This table shows the results of the model that is most parsimonious with respect to the data (see Annex 4 for full methods details and a summary of AIC analyses).

Coefficient	**Parameter estimate**	**Standard error**	***p***
Intercept	2.346	0.188	<0.001
Year2019	-0.180	0.064	<0.01
Year2020	-0.522	0.056	<0.001
DOY	-0.003	0.001	<0.001
Balaclava Bay	-0.198	0.087	<0.05
Portland Harbour & Weymouth bay	0.0133	0.087	0.87899
Ringstead	-0.267	0.087	<0.01
White Nothe to Lulworth	-0.055	0.097	0.57203

Rod and live caught Ballan wrasse

Table 10. Summary of GLM results testing for the main drivers of variation in LPUE of ballan rod and line caught wrasse, showing model coefficients and their standard errors; p < 0.05, p<0.01 and p < 0.001, indicates significance (i.e. whether LPUE is significantly different relative to the mean of all other levels of a factor variable (Year/Area)). This table shows the results of the model that is most parsimonious with respect to the data (see Annex 4 for full methods details and a summary of AIC analyses).

Coefficient	**Parameter estimate**	**Standard error**	***p***
Intercept	4.248	0.415	<0.001
Year2019	0.580	0.172	<0.001
West side	0.059	0.434	0.891
Portland Bill	1.586	0.443	<0.001
Balaclava Bay	-2.240	0.511	<0.001
Portland Harbour	4.869	2.334	<0.05
Weymouth Bay	-0.526	0.555	0.344
Ringstead	-2.305	0.423	<0.001