The Live Wrasse Fishery 2021

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Cover image: Goldsinny wrasse (*Ctenolabrus rupestris*)
observed in Devon and Severn IFCA's District
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Contents

1. Introduction

1.1. Development of the Commercial Live Wrasse Fishery

Since the late 1980s, inshore fisheries have developed in Norway, Scotland and Ireland for several wrasse species, namely: ballan (*Labrus bergylta*), corkwing (*Symphodus melops*), goldsinny (*Ctenolabrus rupestris*), rock cook (*Centrolabrus exoletus*), and cuckoo (*Labrus mixtus*) wrasse. These species are targeted for use as a biological control mechanism for the control of ectoparasites (Copepoda, Caligidae) in farmed Atlantic salmon (*Salmo salar*) (Bjordal, 1988, 1991; Treasurer, 1994; Tully *et al.*, 1996; Varian *et al.*, 1996). The use of wrasse as cleaners is suggested by some to be the most economical and environmentally friendly option for removal of sea lice (Treasurer, 2012; Liu and Bjelland, 2014) compared to other methods such as pharmaceutical, thermal and mechanical treatments (Roth *et al.*, 1993; Burka *et al.*, 1997; Burridge *et al.*, 2010; Overton *et al.*, 2019). Now large numbers of these cleanerfish are routinely being used in salmon aquaculture, with several million used each year in Norway alone (Darwall *et al.*, 1992; Skiftesvik *et al.*, 2014).

With the continued expansion of the Scottish salmon aquaculture industry, there has been an increase in the demand for wrasse to use as part of lice control strategies. This increased demand, and limited stocks of wrasse in Scottish waters (Rae, 2002), eventually put pressure on Scottish salmon companies to source wrasse from other locations around the UK, such as the south coast of England. Consequently, live wrasse fisheries developed in Cornwall, Devon and Dorset on the south coast of the UK in around 2015 (Davies, 2016; Street *et al.*, 2017; Gravestock, 2018).

1.2. History of the Live Wrasse Fishery in Devon & Severn IFCA's District

A fishery for the live capture of wrasse for use as cleaner fish in Scottish salmon farms developed in the D&S IFCA's District in 2015. Management was introduced in 2017 via the D&S IFCA Potting Permit Byelaw following a detailed literature review of the potential impacts of the Live Wrasse Fishery in 2016, which included evidence of impacts from other Live Wrasse Fishery locations.

The fishery in D&S IFCA's District comprised of up to four vessels per year, each ranging from approximately five to ten metres in length. Over the course of 2017–2020, some vessels have left the fishery and been replaced by new entrants. In 2020, Vessels 3, 4 and 6 were active in D&S IFCA's District. Vessel 3 appears to have had minimal involvement in the Live Wrasse Fishery, Vessel 4 was predominantly active in Cornwall IFCA (CIFCA)'s District, but typically set a single string of approximately 40 pots in D&S IFCA's District on each trip, while Vessel 6 set up to six strings, each of 20 pots, entirely within D&S IFCA's District on each trip.
Table **1** summarises anonymised details of each vessel for context.

Fishers set strings of lightweight, rectangular wrasse parlour pots (traps) in varying numbers. All pots are manufactured by Carapax (Lysekil, Sweden), and are usually baited with crabs or bait balls to attract wrasse. Pots are designed to exclude bigger fish and are fitted with escape gaps to allow smaller wrasse to escape. Differences in fishing practices between fishers (vessels) relate to fisher preferences for fishing location, soak time (duration of trap deployment) and bait type.

Table 1. Summary of vessels actively fishing for wrasse in D&S IFCA's District during 2017–2020.

Vessel number	Years active	Comments
1	2017	Fished in both CIFCA's and D&S IFCA's Districts.
2	2017 – 2019	Fished in both CIFCA's and D&S IFCA's Districts.
3	2017 – 2020	Fished in both CIFCA's and D&S IFCA's Districts. Minimal known activity in D&S IFCA's District in 2020.
4	2017 – 2020	Predominantly fished for wrasse in CIFCA's District. Typically used up to two strings of pots in D&S IFCA's District on each trip.
5a	2018	Same skipper as 5b, changed vessel during 2018. Fished in both CIFCA's and D&S IFCA's Districts.
5b	2018	Same skipper as 5a, changed vessel during 2018. Fished in both CIFCA's and D&S IFCA's Districts.
6	2019 – 2020	Fished entirely in D&S IFCA's District, typically along the eastern coastline of Plymouth Sound.

The management measures implemented in June 2017, through permit conditions associated with the Potting Permit Byelaw (Clark and Townsend, 2017) included a pot limit of 120 pots per permit holder (and an understanding that there would be up to four permit holders actively fishing for wrasse at any one time), maximum and minimum Conservation Reference Size (CRS) limits for each species, closed seasons, voluntary closed areas, and requirements for fishers to document and report their daily effort, landings and fishing locations. D&S IFCA's Environment Officers also carried out onboard observer surveys on a proportion of the fishing trips to record a more detailed sample of catch and landings. The data from these observer surveys have formed the basis for most of the analyses in each of the annual monitoring reports to date.

The Potting Permit Byelaw permit conditions have been adapted a number of times on the basis of analyses carried out on the data collected by D&S IFCA during observer surveys. These analyses provided evidence on possible improvements to management to further ensure the sustainable management of the fishery in D&S IFCA's District. For example, following analysis of observations of spawning wrasse during observer surveys in the first year of data collection, the closed season was changed to better protect spawning individuals. In addition, in 2018 the CRS limits of corkwing wrasse were changed to increase the proportion of this species that was returned to the sea, and so afford protection to greater proportions of smaller and larger individuals of the species. Following the Three Year Comprehensive Review of the fishery in D&S IFCA's District (Curtin *et al.*, 2020), D&S IFCA prohibited the removal of rock cook from the fishery due to evidence of a decline in the catches and landings per unit effort (CPUE and LPUE) across the three-year period 2017–2019.

The analyses prior to 2020 were unable to consider changes in CPUE and LPUE whilst controlling for variation that comes about as a result of geographical location and environmental variables. In the most recent report reviewing the fishery between 2017–2020, D&S IFCA was able to use methods adapted from Henly *et al.* (2021) to calculate

standardised CPUE and LPUE from observer survey data. This analysis allows a relatively quick assessment of stock abundance dynamics (Metri *et al.*, 2014) and can be used to robustly assess fishery effects on target species (Henly *et al.*, 2021). Standardisation of CPUE and LPUE accounts for the influence of spatial and environmental variables on catch rates, allowing for a more accurate representation of stock abundance dynamics over time (Maunder and Punt, 2004; Venables and Dichmont, 2004). It also permits identification of the variables that influence catch rates, and can therefore provide information on the ecology and population dynamics of the target species that can help inform management decisions (Maunder and Punt, 2004). Following this analysis, the B&PSC agreed to change the ballan wrasse CRS range from 15 – 23cm to 18 – 26cm and removed the requirement for wrasse fishers to submit returns forms. The proposed change in the ballan wrasse CRS range went out to public consultation and was brought into force in August 2021.

The current and previous management measures are summarised in D&S IFCA's Byelaw Status and Changes Guide (Townsend, 2021).

2. The Live Wrasse Fishery in D&S IFCA's District in 2021

The Live Wrasse Fishery opened on 16th July 2021, but no fishing for live wrasse has taken place this season, initially due to mechanical problems with one of the permitted vessels. Though the second permitted vessel had no such problems, this fisher recognised that wrasse should not be held in storage areas for extended periods, and therefore decided not to fish as he would not be able to catch enough wrasse in a short timeframe to warrant booking a transport to Scottish salmon farms.

Wrasse fishers in D&S IFCA's District have supplied wrasse to the same Salmon Farm Agent since 2017. Via e-mails and phone calls with Officers in mid-August 2021, this Agent confirmed his intention to stop sourcing wrasse from D&S IFCA's District, with immediate effect. The Agent cited the mechanical issues highlighted above as an underlying element in this decision, but also indicated that the continued prohibition on removing rock cook wrasse from the fishery was a determining factor. Officers understand that the Agent will also stop receiving live wrasse caught in the Cornish side of Plymouth Sound.

3. The Future of the Live Wrasse Fishery in D&S IFCA's District

As there is no longer a viable market for those who would otherwise target live wrasse in D&S IFCA's District, Officers have requested that the fishers in question return the identification tags used to mark wrasse pots. The use of unmarked pots for the capture of live wrasse would be in contravention of the Potting Permit Byelaw Conditions. Enforcement patrol by D&S IFCA will monitor potting in the Plymouth Sound. The future of the Live Wrasse Fishery in D&S IFCA's District therefore remains uncertain and will likely be partly shaped by the ability of wrasse aquaculture facilities and other Live Wrasse Fisheries to meet demand from salmon farms. Though the Salmon Farm Agent indicated no clear intention to begin sourcing wrasse from Devon in future years, he also suggested that the production of wrasse in aquaculture facilities (an alternative to live capture of wrasse) is slow and somewhat unreliable, and that the cleaning efficacy of cultured wrasse remains untested.

4. Reflections on D&S IFCA's Management to Date

This break in the District's wrasse fishery provides an opportunity to reflect on D&S IFCA's management decisions to date in the context of advances that have been made in the literature since D&S IFCA's first literature review in 2016.

D&S IFCA (alongside other IFCAs on the south coast of the UK) was able to introduce management measures for the Live Wrasse Fishery in the District over a comparatively short timescale when compared with other locations where the fishery has developed previously. Live Wrasse Fisheries began in Scotland and Norway in the late 1980s, but management measures for Scotland were only introduced in May 2021 and comparatively fewer conservative restrictions were introduced in Norway in 2011, only having been adapted to be more restrictive in the last few years. In comparison to these locations, the introduction of management measures and response to the fishery on the south coast of the UK was much faster and more precautionary, which greatly reduced the chance of overexploitation of wrasse, particularly in D&S IFCA's District, where restrictions were introduced in 2017. After becoming aware of the fishery, which started in 2015, D&S IFCA conducted a literature review of the potential impacts of the Live Wrasse Fishery in 2016, based on the biology and ecology of wrasse, as well as evidence of impacts that had already been observed in Norway and Scotland. Management measures were then developed and implemented in 2017, just two years after the start of the fishery.

As highlighted in the recent publication by Henly *et al.* (2021), management of small-scale inshore fisheries "is made difficult by this sector's ability to diversify more quickly than management can adapt, exploiting multiple species through changing technology, new market niches and flexibility in time spent fishing (Symes and Phillipson, 2001)". As shown throughout the development of the Live Wrasse Fishery in the District, D&S IFCA's permit-based management system is adaptive and agile and allows rapid responses to new evidence of fisheries as and when it becomes available. Since their implementation, the Live Wrasse Potting Permit Conditions have been adapted several times to reflect the findings from Officer's annual reports of the fishery. In each report, evidence gathered from fishery observer surveys in the District has been used to scrutinise the potential for the ongoing sustainability of the fishery. In earlier years, the data gathered was able to provide descriptive evidence that could be used to adjust permit conditions to better suit the local wrasse populations, whereas in later years as more data had been collected more comprehensive statistical methods were able to be used to assess the sustainability of the fishery and trends in catches and landings over multiple years. The standardisation of CPUE and LPUE data in the 2020 report helped to identify which trends were most likely to be a result of changes in fishing pressure as opposed to varying environmental and geographical variables between years.

The Nordic Council of Ministers recently commissioned a report that collates evidence on cleaner fish fisheries in Scandinavia and the UK and provides management recommendations on how the fisheries and use of cleaner fish can become more sustainable (Halvorsen *et al.*, 2021). In the report, the management measures for wrasse fisheries in Norway, Sweden, Denmark and the UK are outlined and combined with evidence of the biology and ecology of wrasse to recommend management measures to increase the sustainability of Live Wrasse Fisheries. Recommendations are made on the appropriate management unit size for wrasse, quotas, size limits, gear regulations, bycatch regulations, closed seasons and closed areas. These recommendations and how they relate to D&S IFCAs current management are outlined in the following sections.

4.1. Management Units

Halvorsen *et al.* (2021) highlights that it is important that management units are based on meaningful biological units, such as areas with defined local adaptation and population structure. If population structure is present, one would see multiple genetically distinct populations of a species, with limited movement between each population (e.g. Figure 1a), instead of a single large, interconnected population (e.g. Figure 1b). If such population structure is ignored when defining management units for wrasse, there is a risk of overexploiting one of those populations with might remove some important local genetic adaptation without the possibility of recovery (Reiss *et al.*, 2009; Funk *et al.*, 2012).

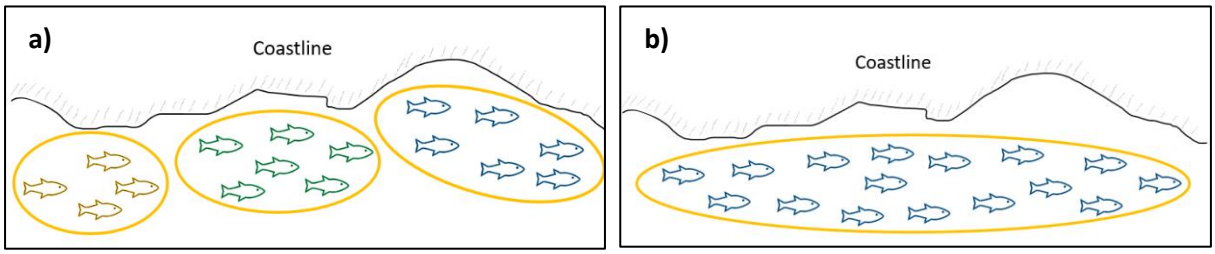

Figure 1. Schematic example of **(a)** a fish species showing population structure along a coastline – i.e. multiple, genetically distinct populations, with limited movement between populations, and **(b)** a fish species with no population structure along a coastline – i.e. one, large, interconnected population, with movement throughout. If one of the populations in **(a)** is over-exploited, local genetic adaptations within that population might be lost and there is a risk of local extinction of the species due to very limited movement between populations. On the other hand, if the same small section of coastline is over exploited in **(b)** there is a greater chance of recovery as there is movement and mixing along the coastline, allowing recolonisation of the over fished area.

Currently, each species of wrasse in D&S IFCA's District is managed as a single entity or population. When wrasse fishing was occurring in the District, it was geographically limited to Plymouth Sound and did not occur in any other areas of the District. Although there are currently no studies into the population structure of wrasse on the south coast of the UK, evidence from previous such studies in Scandinavia suggest that despite the limited home range sizes of most wrasse species (Barrett, 1995; Morel *et al.*, 2013; Villegas-Ríos *et al.*, 2013), fine scale population structure (i.e. at scales at or smaller than the size of Plymouth Sound) is unlikely. Wrasse along the Norwegian North Sea coast were genetically varied compared to those on the Skagerrak coast (Jansson *et al.*, 2017, 2020; Faust *et al.*, 2018; Seljestad *et al.*, 2020), however within these large geographic regions there is very little population structure (Jansson *et al.*, 2017; Seljestad *et al.*, 2020).

Based on this evidence, local overharvest of small-scale areas is unlikely to result in a loss of genetic variation and local extinction of the species, as long as the overexploitation does not occur in all local management areas simultaneously, and migration between areas is frequent (Halvorsen *et al.*, 2021). It is also important to consider that wrasse populations are exploited simultaneously in multiple locations along the south coast, including in Dorset and Cornwall. Additionally, as Plymouth Sound is designated as a European Marine Site, D&S IFCA has a duty to protect the integrity of the site, and balance those needs with the social and economic benefits of fishing activity; therefore, management of the wrasse fishery in the site necessary to ensure these duties are met. The PhD study at the University of Exeter, which is investigating the Live Wrasse Fishery on the south coast of the UK, is currently exploring the population structure of wrasse across the South West IFCA Districts. The results from this study will be used to determine the level of population structuring in

Plymouth Sound and along the coast, and could aid any future decisions on defining management units for wrasse along the south coast as a whole.

4.2. Quotas

The core focus of sustainable fisheries management is generally to have an estimation of stock abundance, with the ultimate goal of determining a Maximum Sustainable Yield (MSY), "the largest average catch or yield that can be continuously taken from a stock under existing environmental conditions" (Ricker 1975). MSY can then be used to inform quotas, which can be set to regulate fishing effort. However, the calculation of MSY to inform quotas requires many years of detailed data to feed into complex fisheries models and stock assessments. Currently, quotas are only used in Norway to regulate the number of wrasse caught each year. These quotas are based on annual advice from the Institute of Marine Research, but ultimately decided by the Norwegian Directorate of Fisheries (Halvorsen *et al.*, 2021).

On the other hand, calculation of measures such as Catch Per Unit Effort (CPUE) can be used to obtain a relatively quick assessment of stock abundance dynamics. Due to the relatively small scale of the wrasse fishery in D&S IFCA's District, the calculation of CPUE and LPUE is sufficient for the current level of management required for the fishery.

4.3. Size limits

Size limits are a widespread management tool for coastal fisheries. It is generally recommended to aim to allow fish to spawn at least once before reaching harvestable size (Froese, 2004). Halvorsen *et al*. (2021) recommends that size limits should be set according to the life history of each wrasse species, but the complex and varying life histories and reproduction strategies of wrasse species (detailed in Darwall *et al*. (1992)) makes setting appropriate size limits complicated. In particular, setting a single minimum size limit is unlikely to protect sufficient proportions of both sexes of hermaphroditic species (ballan and cuckoo) and species where growth rate and maturity varies with sex (corkwing and goldsinny). Halvorsen *et al*. (2021) therefore recommends slot size limits should be set, which would allow both small and large individuals to be protected to maintain the reproductive potential of the population (Froese, 2004). The size limits recommended for Norwegian wrasse are detailed in Table 2. Rock cook and cuckoo wrasse are not commonly caught in Norway, so they have not been included in Table 2. It is important to note that the length at maturity estimates in the table are based on data from yearly surveys of the Norwegian fishery, which has undergone many years of intense fishing pressure. The intense fishing pressure experienced in Norwegian waters may have altered the length at maturity of some species (Halvorsen *et al.*, 2017). There are other estimates of length at maturity in the literature that may be more relevant to the wrasse on the south coast of the UK, but the estimates provided in Table 2 provide an overly precautionary estimate based on a previously intensely fished region.

Table 2: Adapted from Halvorsen *et al*. (2021). Summary of key reproductive life history traits of ballan, corkwing and goldsinny wrasse in Norway. The advised size limits for the Norwegian fishery and current size limits in the D&S IFCA fishery are also shown.

Species	Parental care	Sex Change	Max age and length	Length at maturity (Norway)	Advised size limits (Norway)	D&S IFCA size limits
Ballan	Yes	Yes	29 yrs 50 cm	Female: 22 cm Male: 30–40 cm	Min: 22 cm Max: 28 cm	Min: 18 cm Max: 26 cm
Corkwing	Yes	No	9 yrs 25 cm	Female: 10 cm Male: 15 cm	Min 13 cm	Min: 14 cm Max: 18 cm

Goldsinny	No	No	20 yrs 20 cm	Sneaker male: 8 cm 8 cm	Min: 11 cm Max: 14 cm Or Min: 12 cm Max: NA	Min: 12 cm Max: 23 cm

Currently in the D&S IFCA's District there are species-specific Conservation Reference Size (CRS) ranges for wrasse. The CRS ranges for both ballan and corkwing wrasse have changed, but goldsinny has remained the same since the introduction of wrasse management in the District. The most recent change to the ballan wrasse slot size from 15–23cm to 18–26 cm brought the ballan size limits closer to those recommended by Halvorsen *et al*. (2021) and more in line with the measures adopted by Southern IFCA, whose recent report found no decline in ballan wrasse LPUE across a three year period (Smith and Henly, 2021). The new size limits are likely to increase the proportion of mature females that are returned to the sea and can subsequently reproduce. Although the Norwegian report has recommended a minimum size of 22 cm, this may be a result of an inflated length at maturity for ballan wrasse due many years of intense fishing pressure. Based on the evidence in the literature for length at maturity for ballan wrasse in locations other than Norway, the new ballan wrasse size limits in D&S IFCA's District are likely to be sufficient at protecting some mature individuals of both sexes to maintain the reproductive potential of the population.

The CRS ranges for corkwing and goldsinny wrasse in the D&S IFCA's District lie within the recommendations from the Halvorsen *et al*. (2021) report, and in the case of corkwing wrasse are more precautionary than those recommended, based on site-specific evidence from D&S IFCA's District. The maximum size limit for goldsinny wrasse is likely to be biologically arbitrary as the largest size recorded for the species is 20 cm.

4.4. Gear regulations

Gear regulations are common in other wrasse fisheries, including those in Scandinavia and elsewhere in the UK. Halvorsen *et al*. (2021) highlight that even small alterations in gear design can affect the size selectivity and catch efficiency of both target species and bycatch. Common gear regulations can include limitations on the type and amount of gear used, maximum entrance sizes on pots, and the size and position of escape openings.

Fishers in the D&S IFCA's District exclusively fish with pots, despite some fishers in other Districts on the south coast also fishing with rod and line to target larger wrasse species. The pots used must include a hard/ rigid eye that does not exceed a 9 cm diameter and at least two unobstructed vertical escape gaps (7 cm height, 1 cm width). There is a pot limit of 120 pots per permit holder (each to be marked with an identifying pot tag), and D&S IFCA's Byelaw and Permitting Sub-Committee has determined that a total of 480 pot tags will be available for the fishery in each year. This approach has a number of advantages. For example, if at any time in the future more than 4 vessels enter the Live Wrasse Pot Fishery, this will trigger a review of the Permit Conditions for the Live Wrasse Pot Fishery and may lead to further changes to the Potting Permit Conditions, which may include a reduction in the number of pots per vessel. Based on these conditions, if there is a shift of commercial pressure to the D&S IFCA Live Wrasse Fishery for any reason, D&S IFCA would be able to review the pot limitation Permit Conditions if necessary, to ensure the continued sustainability of the fishery.

4.5. Bycatch regulations

Most fisheries aim to minimize bycatch, and there are various measures that can be used to achieve this in wrasse fisheries. Regulations or codes of practice can also be used to guide the handling of bycatch when captured to avoid unnecessary losses. Halvorsen at al. (2021) recommend that the entrance gaps for gear should be as small as possible, and escape gaps should be installed to allow smaller wrasse and other species to escape. If caught, Halvorsen at al. (2021) recommends that bycatch should be immediately released, with measures taken to reduce predation by seabirds.

In D&S IFCA's Live Wrasse Fishery, between 30–75% (depending on species) of the wrasse caught in pots are outside of the CRS range that is permitted to be removed from the fishery, but the proportion of other species of bycatch have not been calculated. Fishers in the District immediately return to the sea any species that is caught as bycatch in wrasse pots during routine fishing; most fishers are also aware of the predation risk from seagulls and take precautions to reduce this (*pers. obs.*).

4.6. Closed seasons

Closed seasons for Live Wrasse Fisheries are common. And Halvorsen *et al*. (2021) recommends that fishing for wrasse should not be permitted during the spawning season. Male wrasse become territorial, while ballan, corkwing and cuckoo wrasse exhibit parental care over the spawning season, which makes them particularly vulnerable to fishing during this period (Halvorsen *et al.*, 2021).

In 2017 in the D&S IFCA's District, closed seasons were implemented based on evidence of spawning seasons from the literature, and with negotiation with fishers and salmon farms. The fishery was closed between 1st April and 30th June, but records of spawning individuals seen during observer surveys in 2017 prompted a change in management from 2018 onwards, when the closed season was 1st May to 15th July. Checking for spawning is still a key part of the fishery observer surveys in the D&S IFCA's District, however the accuracy of observations is unknown. There is a need for more localised studies that accurately identify and monitor the spawning seasons for wrasse on the south coast of the UK.

4.7. Closed areas

A number of studies have shown that closed areas can be effective tools for management of species with small home range sizes such as wrasse (Barrett, 1995; Morel *et al.*, 2013; Villegas-Ríos *et al.*, 2013). In Norway, for example, MPAs have been associated with positive effects on abundance, mortality, and size structure of wrasse (Halvorsen *et al.*, 2017).

D&S IFCA developed a range of small voluntary closed areas with their initial management measures in 2017. After some minor changes to these in 2018 following consultation with stakeholders, including fishers, these have remained unchanged since. The closed areas have remained voluntary, with good compliance from fishers. Having voluntary closed areas allows D&S IFCA to involve the stakeholders resulting in a valued co-management approach that is thought to improve compliance over entirely top-down imposition of management measures. Several studies (e.g. Costanza *et al.*, 1998), suggest that this type of management of inshore fisheries management leads to a sustainable fishery and helps promote a shift in the incentive structure from defensive to proactive (Arlinghaus *et al.*, 2019).

5. Conclusions

Although there is no longer a viable market for those who would otherwise target live wrasse in D&S IFCA's District, this break in the District's wrasse fishery has provided an opportunity to reflect on D&S IFCA's management decisions to date in the context of advances that have been made in the literature since D&S IFCA's first literature review in 2016. Reviewing D&S IFCA's management measures in this way ensures knowledge on the most recent research is up to date, which will be useful if the fishery begins again in future years.

D&S IFCA's current management measures appear to match most of the recommendations that have been made recently in a review of management measures of cleanerfish fisheries (Halvorsen *et al.*, 2021). These recent recommendations, which were made for the Norwegian fishery, may be more precautionary than is needed in the D&S IFCA District as the fishery in Norway is happening on a much larger scale, and has been occurring for many more years than that in D&S IFCA's District. Nevertheless, it is likely that D&S IFCA's current management is sufficient to ensure sustainability of wrasse stocks if the Live Wrasse Fishery were to begin again in the future.

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