MARINE CONSERVATION SOCIETY

# Use of 'Cleaner Fish' in UK aquaculture: Current use, concerns and recommendations.

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# Summary

Sea lice cause major health issues for farmed Atlantic salmon and represent one of the major threats to the salmon farming industry. Currently, treatment of sea lice is dependent on: a range of anti-parasitic chemical treatments (both bath and in-feed); a number of technical solutions such as warm water treatments and hydro removal; and biological control, with the deployment of cleaner fish species into salmon farms. The use of cleaner fish decreased when effective chemotherapeutics for lice control were developed and applied. Catches remained relatively low throughout the 1990s and 2000s when they were only complementary to chemical treatment.[1] Once salmon lice began developing resistance to the chemicals used, this triggered a renewed interest and an increased demand for cleaner fish[2] led by the salmon farming industry.

Ballan wrasse and Lumpfish are the predominant species used as cleaner fish. A significant demand is placed on wild capture fisheries to fulfil this requirement despite the advent of farming for both species. However, the wild capture fisheries are mostly unregulated with limited enforceable management measures in place to maintain healthy populations and ensure their sustainable exploitation. Welfare of cleaner fish during capture, storage, transport and deployment is also of concern.

Mandatory control measures for the Scottish wrasse fishery have been developed, alongside wrasse fishery guidance and other mandatory management measures in the south west of England, which address some of the issues of concern. It is recommended that mandatory management measures become widely adopted in all wrasse fisheries, and are evidenced to be appropriate for the species being targeted. Conversely, there are no management measures in place for Lumpfish fisheries in the United Kingdom. It is recommended that this lack of management is addressed with appropriate measures being adopted in all Lumpfish fisheries.

The interest of the fish farming sector on cleaner fish has increased substantially since 2008. Approximately 60 million cleaner fish are used each year in the salmon farming sector, with an estimated demand of 10 million in the UK alone (mostly Lumpfish). It is therefore imperative that best practice is defined and applied to their production.

With the use of one cleaner fish per 25 salmon, the use of cleaner fish also represents a significant fish protein source that is currently not used at the end of production cycle. This equates to a significant protein loss. To mitigate this, we would like to see a market being developed for their post-harvest use, to ensure the cleaner fish are utilised rather than slaughtered and discarded.

The impact of escaped cleaner fish on the genetic diversity of the wild populations around the farm is largely unknown, and therefore of great concern. There are genetic gaps between wild populations per

[1] Olsen, E. M., Halvorsen, K. T., Larsen, T. and Kuparinen, A. (2019). Potential for managing life history diversity in a commercially exploited intermediate predator, the goldsinny wrasse (Ctenolabrus rupestris). *ICES Journal of Marine Science*, 76(2), pp. 410–417. Available at doi:10.1093/icesjms/fsy183 [Accessed 23.09.2020]

[2] Anne Berit Skiftesvik, Geir Blom, Ann-Lisbeth Agnalt, Caroline M.F. Durif, Howard I. Browman, Reidun M. Bjelland, Lisbeth S. Harkestad, Eva Farestveit, Ole Ingar Paulsen, Merete Fauske, Trond Havelin, Knut Johnsen and Stein Mortensen (2014). Wrasse (Labridae) as cleaner fish in salmonid aquaculture – The Hardangerfjord as a case study, *Marine Biology Research*, 10(3), pp.289-300. Available at https://www.tandfonline.com/doi/full/10.1080/17451000.2013.810760#:~:text=Several%20species%20of%20wrasse%20(Labridae,lice%20from%20farmed%20Atlantic%20salmon [Accessed 22.09.2020]

region, and any escaped farmed cleaner fish could impact the genetic diversity of local wild stocks. It is imperative we increase our understanding of these impacts via dedicated research. A precautionary approach should be employed in the interim when using wild caught cleaner fish, by only deploying those from well managed local stocks.

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# 1.0 Introduction

Sea lice are naturally occurring ectoparasitic copepods that attach themselves to marine fish and feed on mucus, skin and blood of their host. The salmon louse - *Lepeophtherius salmonis,* is of particular concern as it causes major health issues for farmed salmon including fin damage, skin erosion, wounds and a reduction in overall health and performance. If sea lice numbers are sufficient death can also occur.[3] In 2019, global production of farmed Atlantic salmon increased to 2.6 million tonnes (the largest annual increase (7%) since 2014).[4] Scottish salmon production saw a growth increase of around 20%, with the latest forecasts expecting global production to rise a further 2-4% in 2020.[5] However, increasing pressure from sea lice and sea lice management brings financial burden for salmon farmers.[6] The control of sea lice numbers is paramount for successful production and the health of fish.

Sea lice management also causes environmental concerns. The organophosphate chemicals used to kill the sea lice are released into the surrounding waters post-treatment, whether the treatments used are the bath type or medicated in-feed variety. There are growing evidences showing that anti-sea lice pesticides are toxic to non-target species, particularly crustaceans, and their direct release into the marine environment is an increasing cause for concern[7] for biodiversity and inshore fisheries. Also of concern is the transmission of sea lice to wild salmonids (salmon and trout) in the vicinity of the farms[8] and the increasing resistance to the efficacy of the chemical treatments.[9] Increased chemical resistance combined with the limited array of treatments available and the prevalence of sea lice, has led to research into innovative methods of sea lice control. One of these methods - the use of cleaner fish - proved successful and has now become a widely deployed sea lice control measure.

'Cleaner fish' is an overarching term used to refer to species that are deployed in salmon or trout cages who pick off and eat sea lice off passing fish. The predominant species used are Lumpfish (*Cyclopterus lumpus*) and wrasses (Family: Labridae), in particular Ballan wrasse (*Labrus bergylta*). The use of cleaner

[3] Pike, A and Wadsworth, S (2000), Sea lice on salmonids: their biology and control. Advances in Parasitology. 44, 233-337 2 Wotten, R., Smith, J.W and Needham, E.A (1982). Aspects of the biology of the parasitic copepods Lepeophtheirus.

[4] Mereghetti, M. (2020). Global salmon production set to rise in 2019 the highest increase since 2014. Available at https://www.undercurrentnews.com/2019/12/05/global-salmon-production-set-to-rise-6-5-in-2019-the-highest-increase-since-2014/ [Accessed 28.10.2020]

[5] FAO (2020). Widespread distribution in the salmon sector. http://www.fao.org/in-action/globefish/market-reports/resource-detail/en/c/1306829/ [Accessed 28.10.2020]

[6] FAO (2020). Higher than expected growth supply in 2019 but sea lice issues continue. Available at http://www.fao.org/in-action/globefish/market-reports/resource-detail/en/c/1253536/ [Accessed 28.10.2020]

[7] Parsons, A. *et al.* (2020). The impact of anti-sea lice pesticides, azamethiphos and deltamethrin, on European lobster (*Homarus gammarus*) larvae in the Norwegian marine environment. *Environmental Pollution*, 264 (114725). Available at https://www.sciencedirect.com/science/article/pii/S0269749120302451#bib54 [Accessed 29.10.2020]

[8] R. M. Serra-Llinares., P. A. Bjorn., B. Finstad., R. Nilsen., A. Harbitz., M. Berg. and L. Asplin. (2014). Salmon lice infection on wild salmonids in marine protected areas: an evaluation of the Norwegian 'National Salmon Fjords. *Aquaculture Environment Interactions,* 5, pp. 1–16.

[9] Aaen, S., Helgesen, K., Bakke, M., Kaur, K. and Horsberg, T. (2015). Drug resistance in sea lice: a threat to salmonid aquaculture. *Trends in Parasitology,* 31(2), pp. 72-81.

fish as a biological control of sea lice is not novel. Wrasse have been used in Norwegian salmon farms since the late 1980s, and was shortly followed by Scotland, England and Ireland around the same time.[10]

Cleaner fish can be wild-caught or farmed. In regards to wild caught fish, there are a number of concerns about supplying this increasing demand in relation to overfishing, local population demise and fish welfare. With the exponential increase in the use of cleaner fish, questions are raised regarding their origin, the sustainability of their sourcing, and their welfare and survival.

[10] Anne Berit Skiftesvik, Geir Blom, Ann-Lisbeth Agnalt, Caroline M.F. Durif, Howard I. Browman, Reidun M. Bjelland, Lisbeth S. Harkestad, Eva Farestveit, Ole Ingar Paulsen, Merete Fauske, Trond Havelin, Knut Johnsen & Stein Mortensen (2014). Wrasse (Labridae) as cleaner fish in salmonid aquaculture – The Hardangerfjord as a case study, *Marine Biology Research*, 10(3), pp.289-300. Available at https://www.tandfonline.com/doi/full/10.1080/17451000.2013.810760#:~:text=Several%20species%20of%20wrasse%20(Labridae,lice%20from%20farmed%20Atlantic%20salmon [Accessed 22.09.2020]

## 2.0 Cleaner fish species

Previous studies and trials with cleaner fish in the 1990's used a number of different wrasse species including Goldsinny, Rockcook and Corkwing, as well as Ballan. Cuckoo wrasse occupies deeper waters and were thought to be unsuitable to deploy in shallower salmon cages. More recent use, of cleaner fish, has concentrated on Ballan wrasse and Lumpfish, and it is these two species that are currently being farmed to supply the demand created by the salmon farming industry.

Table 1. Summary of cleaner fish species (Data source: FishBase[11])

| | | |
|---|---|---|
| **Ballan wrasse** (*Labrus bergylta*) | Largest wrasse species in northern Europe.<br>**Resilience**: Low<br>**Vulnerability**: High to Very High<br>**Breeding season**: April – August<br>**Size at maturity**: 16 - 18 cm (6 to 9 years ♀)<br>Reported age: 29 years<br>Maximum length: 66 cm |  <br>© MCS/Paul Naylor |
| **Lumpfish/ lumpsuckers** (*Cyclopterus lumpus*) | More cold-resistant than wrasse.<br>**Resilience**: Low<br>**Vulnerability**: Moderate to High<br>**Breeding season**: June – August (NE Atlantic), February – May (Baltic sea)<br>**Size at maturity**: Unknown (3 years ♂, 4 years ♀)<br>Reported age: 13 years<br>Maximum length: ♂ 61 cm, ♀ 43 cm |  <br>© OCVA |
| **Corkwing wrasse** (*Symphodus melops*) | Together with goldsinny, the most abundant wrasse in Norwegian and UK waters.<br>**Resilience**: Medium<br>**Vulnerability**: Low to Moderate<br>**Breeding season**: May – July<br>**Size at maturity:** 15 - 17 cm (3 years)<br>Reported age: 9 years<br>Maximum length: 28 cm |  <br>© MCS/Paul Naylor |

[11] Biological data available at www.fishbase.org

| | | |
|---|---|---|
| Goldsinny wrasse (*Ctenolabrus rupestris*) | Together with corkwing, the most abundant wrasse in Norwegian and UK waters.<br>**Resilience**: Medium<br>**Vulnerability**: Low to Moderate<br>**Breeding season**: April – August<br>**Size at maturity:** Unknown (2 years)<br>Reported age: 8 years<br>Maximum length: 18 cm |  <br>© MCS/Paul Naylor |
| Rock cook wrasse (*Centrolabrus exoletus*) | Least common species as cleaner fish.<br>**Resilience**: Medium<br>**Vulnerability**: Low<br>**Breeding season**: May – July<br>**Size at maturity:** Unknown<br>Reported age: 6 years<br>Maximum length: 18 cm |  <br>© MCS/Paul Naylor |
| Cookoo wrasse *(Labrus mixtus)* | A reasonably rare wrasse species.<br>**Resilience**: Low<br>**Vulnerability**: High to Very High<br>**Breeding season**: May – July<br>**Size at maturity:** 16 cm (2 years)<br>Reported age: 20 years<br>Maximum length: ♂ 40 cm, ♀ 30 cm |  <br>© MCS/Paul Naylor |

## 3.0 Demand and sourcing

Worldwide around 60 million cleaner fish are used each year for delousing Atlantic salmon (*Salmo salar)* in salmon farms alone. Approximately 60.5 million cleaner fish were deployed in Atlantic salmon and rainbow trout (*Oncorhynchus mykiss*) farms in Norway in 2019, of which 17.4 million fish were wild-caught, and 43.1 million farmed (comprising 42.4 million Lumpfish and 0.7 million Ballan wrasse).[12] [13] [14] Powell *et al.,* (2018),[15] estimated 10 million cleaner fish to be required in the United Kingdom by 2020, of which most would be Lumpfish. In 2016, UK farmed cleaner fish production was 1.9 million Lumpfish and 118,000 Ballan wrasse; 68% of the total cleaner fish deployed.[16] In 2019, Scottish farmed cleaner fish production was 660,000 Lumpfish and 59,000 Ballan wrasse.[17] Therefore, UK production still has a long way to go in order to end the reliance on wild capture fisheries and fulfil estimated demand.

The suggested ratio of cleaner fish to salmon is 1:25 (i.e., 4% of the salmon stocked).[18] When applying this ratio to the 2019 Scottish salmon production figure of 204,000 tonnes,[19] it would issue Scotland with a requirement of 8.4 tonnes of cleaner fish (assuming all farms deploy them in production and not accounting for mortalities, suggesting the actual figure would be higher).

In Norway, cleaner fish use has been increasing dramatically since 2008. Norwegian farms are heavily reliant on Lumpfish over wrasse species, which accounted for >70% of the cleaner fish deployed in 2019. Lumpfish and Ballan wrasse are both farmed in Norway and taken from Norwegian wild capture fisheries; other wrasse species are only taken from the wild. Lumpfish are predominately farmed (84%

[12] Norwegian Directorate of Fisheries (2020). Cleaner fish (lumpfish and wrasse). Available at https://www.fiskeridir.no/English/Aquaculture/Statistics/Cleanerfish-Lumpfish-and-Wrasse [Accessed 27.10.2020]

[13] The Fish Site (2020). Paper questions cleaner fish efficiency. Available at https://thefishsite.com/articles/paper-questions-cleaner-fish-efficacy [Accessed 27.10.2020]

[14] Barrett, L. *et al*., (2020). Effect of cleaner fish on sea lice in Norwegian salmon aquaculture: a national scale data analysis. International Journal of Parasitology, 50(10-11), pp.787-796. Available at https://www.sciencedirect.com/science/article/abs/pii/S0020751920300126 [Accessed 27.10.2020]

[15] Powell, A., Tresurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Use of lumpfish for sea lice control in salmon farming: challenges and opportunities. *Reviews in Aquaculture*. 10, pp.683-702.

[16] Brooker, A.J., Papadopoulou, A., Gutierrez, C., Rey, S., Davie, A. and Migaud, H. (2018). Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges. *Veterinary Record,* 183, 383. Available at https://dspace.stir.ac.uk/retrieve/0de65831-eb2c-44d5-b0ba-fb34006d8cbf/Brooker_2018%28CleanerFishReview%29.pdf [Accessed 25.08.2020]

[17] Munro, L. (2020). Marine Scotland Science: Scottish Fish Farm Production Survey 2019. Available at https://www.gov.scot/publications/scottish-fish-farm-production-survey-2019/ [Accessed 27.10.2020]

[18] Riley, A., Jeffery, K., Cochrane-Dyet, T., White, P. and Ellis, J. (2017). Northern European Wrasse - Summary of commercial use, fisheries and implications for management. February 2017. Available at https://www.gov.scot/binaries/content/documents/govscot/publications/foi-eir-release/2018/03/foi-18-00461/documents/foi-18-00461-documents-release-2-pdf/foi-18-00461-documents-release-2-pdf/govscot%3Adocument/FoI-18-00461%20%20Documents%20for%20release%202.pdf [Accessed 22.09.2020]

[19] Munro, L. (2020). Marine Scotland Science Scottish Fish Farm Production Survey 2019. Available for download at https://www.gov.scot/publications/scottish-fish-farm-production-survey-2019/ [Accessed 28.10.2020]

in 2019) and wrasses are almost exclusively taken from the wild (96% in 2019), with Ballan wrasse accounting for the remaining 4% farmed.[20]

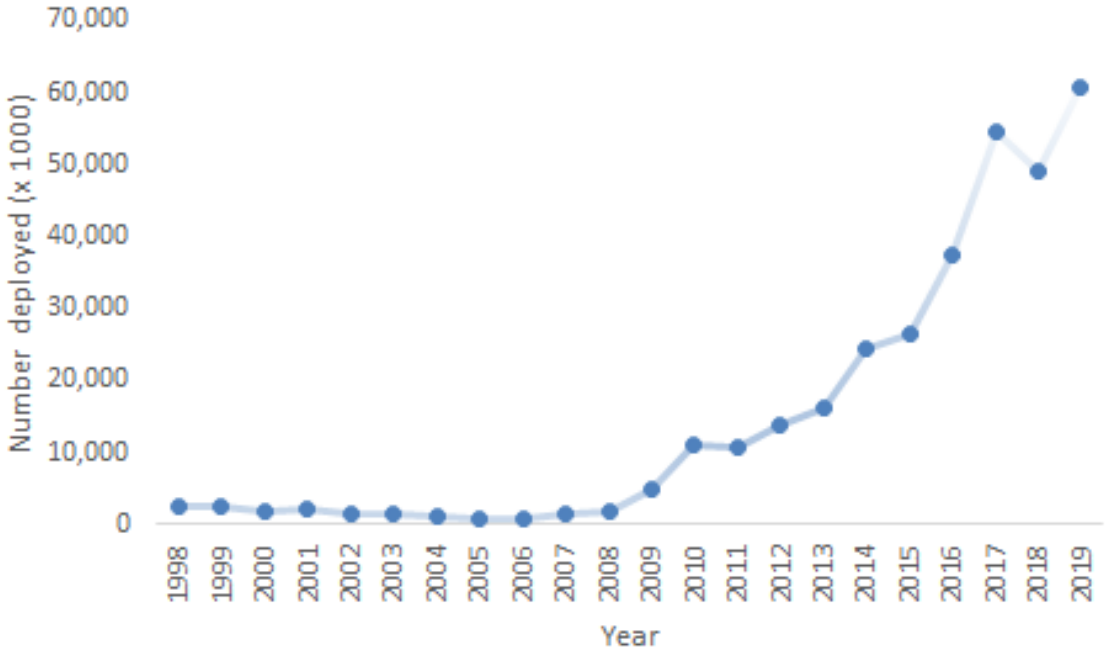


Figure 1. Number of cleaner fish (×1000) deployed in Atlantic salmon and rainbow trout sea cages in Norway during 1998–2019, including both wild-caught and farmed fish (Data source: Norwegian Directorate of Fisheries 2019 [21]).

[20] Norwegian Directorate of Fisheries (2019). Datasets. Available for download at http://www.fiskeridir.no/English/Aquaculture/Statistics/Cleanerfish-Lumpfish-and-Wrasse [Accessed 28.10.2020]

[21] Norwegian Directorate of Fisheries (2019). Datasets. Available for download at http://www.fiskeridir.no/English/Aquaculture/Statistics/Cleanerfish-Lumpfish-and-Wrasse [Accessed 28.10.2020]


Figure 2. Cleaner fish species breakdown (% numbers) deployed in Atlantic salmon and rainbow trout sea cages in Norway during 2019, including both wild-caught and farmed fish (Data source: Norwegian Directorate of Fisheries 2019 [22]).

## 3.1 Wild capture fisheries

### 3.1.1 Wrasse

Almost all wrasse used as cleaner fish come from wild caught populations.[23] Initially, local fisheries took place in Scottish inshore waters but as demand outstripped supply, fisheries expanded in the south west of England. These south west coast fisheries have expanded to such an extent, that it is thought that up to 1 million live wrasses (mixed species, but primarily Ballan wrasse) are caught per annum for transfer

[22] Norwegian Directorate of Fisheries (2019). Datasets. Available for download at http://www.fiskeridir.no/English/Aquaculture/Statistics/Cleanerfish-Lumpfish-and-Wrasse [Accessed 28.10.2020]

[23] Coghlan, A. (2017). Cleaner fish that keep farmed salmon healthy at risk of wipe out. Available at https://www.newscientist.com/article/2125726-cleaner-fish-that-keep-farmed-salmon-healthy-at-risk-of-wipe-out/#:~:text=Almost%20all%20wrasse%20currently%20used,Norway%20come%20from%20wild%20sources. [Accessed 29.10.2020]

to Scottish salmon farms.[24] [25] A further 1 million wrasse fish are estimated to be caught in Scottish waters annually.[26] Dependency could have serious implications on wild wrasse population numbers, particularly as some species have high vulnerability and low resilience to fishing pressures (see Table 1) and little is known about the current stock levels.[27]

Wrasse species are vulnerable to exploitation for a number of reasons:[28]

- Limited home range – high site fidelity can lead to local depletion;
- Longevity – Ballan wrasse may live >20 years;
- Reproduction/Sex ratio – nest guarding by territorial males in several species and protogynous hermaphrodites in some species;
- Temperature related behaviour - reduced activity in winter.

There is some disparity between fisheries management within the United Kingdom. Nonetheless, mandatory input (effort) controls, output (catch) controls and other technical measures are implemented in Scotland and the south of England to protect wrasse species. In England, management consists of voluntary guidance and mandatory management measures implemented by the south west Inshore Fisheries and Conservation Authorities (IFCAs). Despite this, some important management measures are absent alongside data necessary to inform management decisions, which include:

- Stock assessments with associated biological reference points;
- Catch limits or TACs on the fisheries;
- Sound biological and stock dynamics data;
- Robust indicator(s) of stock size or abundance;
- Uncertainties in the scale of fisheries;

[24] Riley, A., Jeffery, K., Cochrane-Dyet, T., White, P. and Ellis, J. (2017). Northern European Wrasse - Summary of commercial use, fisheries and implications for management. February 2017. Available at https://www.gov.scot/binaries/content/documents/govscot/publications/foi-eir-release/2018/03/foi-18-00461/documents/foi-18-00461-documents-release-2-pdf/foi-18-00461-documents-release-2-pdf/govscot%3Adocument/FoI-18-00461%20%20Documents%20for%20release%202.pdf [Accessed 22.09.2020]

[25] Powell, A., Treasurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Use of lumpfish for sea-lice control in salmon farming: Challenges and opportunities. *Reviews in Aquaculture.* 10, pp.683–702. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/raq.12194 [Accessed 25.08.2020]

[26] Fish Farming Expert (2019). Wrasse catch figures show commitment to sustainability. Available at https://www.fishfarmingexpert.com/article/wrasse-catch-figures-show-commitment-to-sustainability/ [Accessed 29.10.2020]

[27] Riley, A., Jeffery, K., Cochrane-Dyet, T., White, P. and Ellis, J. (2017). Northern European Wrasse - Summary of commercial use, fisheries and implications for management. February 2017. Available at https://www.gov.scot/binaries/content/documents/govscot/publications/foi-eir-release/2018/03/foi-18-00461/documents/foi-18-00461-documents-release-2-pdf/foi-18-00461-documents-release-2-pdf/govscot%3Adocument/FoI-18-00461%20%20Documents%20for%20release%202.pdf [Accessed 22.09.2020]

[28] Riley, A., Jeffery, K., Cochrane-Dyet, T., White, P. and Ellis, J. (2017). Northern European Wrasse - Summary of commercial use, fisheries and implications for management. February 2017. Available at https://www.gov.scot/binaries/content/documents/govscot/publications/foi-eir-release/2018/03/foi-18-00461/documents/foi-18-00461-documents-release-2-pdf/foi-18-00461-documents-release-2-pdf/govscot%3Adocument/FoI-18-00461%20%20Documents%20for%20release%202.pdf [Accessed 22.09.2020]

- Steps which address concerns over welfare and mortality during and post capture.

Wrasse capture fisheries are operated by inshore fishers in Scottish and English inshore waters, fishers generally deploy traps and pots to catch the fish, some of which have been specifically designed for the capture of wrasse.

In the United Kingdom, fisheries for wrasse have expanded exponentially since 2013, with more than a 481% increase in landings from 2005 to 2019 (Figure 3). This increase has been driven by high demand which in turn has led to a high unit price of up to £17.50 per live fish, making them the most valuable fisheries species in Europe.[29] It has been voiced that there is anecdotal evidence that the exploitation and shipping of live wrasse from the south west of England to Scotland, is only necessary because of the localised depletion of Scottish stocks by the demand from salmon farms. Little is known about the sustainability of populations and what impact commercial scale harvesting may have on marine ecosystems where wrasse play an important role.[30] [31]

The suggested depletion of Scottish wrasse populations, can be supported by MMO landings data (Figure 3). In 2017, a sudden decline in WRA (wrasses) landings historically reported for Scottish regions, was evident after three years of significantly increased exploitation. This aligns with a significant increase in reported USB (Ballan wrasse) landings reported for English regions, and the development of the Ballan wrasse fishery in England. Notably, annual landings fluctuations can be indicative of 'boom and bust' fisheries, in which catches increase while demand is high, until catch rates become less economically attractive. Initially, landings from newly discovered fisheries may be high and then rapidly decline to very low levels.

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[29] Salmon Business Editorial Staff (2019). Scottish Salmon Producers Publishes Wild Catch Wrasse Data. Available at https://salmonbusiness.com/scottish-salmon-producers-organisation-publishes-wild-catch-wrasse-data/ [Accessed 29.10.2020]

[30] Angling Trust (2020). Save Our Wrasse. Available at https://anglingtrust.net/save-our-wrasse/ [Accessed 29.10.2020]

[31] The Fish Site Editors (2017). Dirty words over cleaner fish fishery. Available at https://thefishsite.com/articles/dirty-words-over-cleanerfish-fishery [Accessed 29.10.2020]

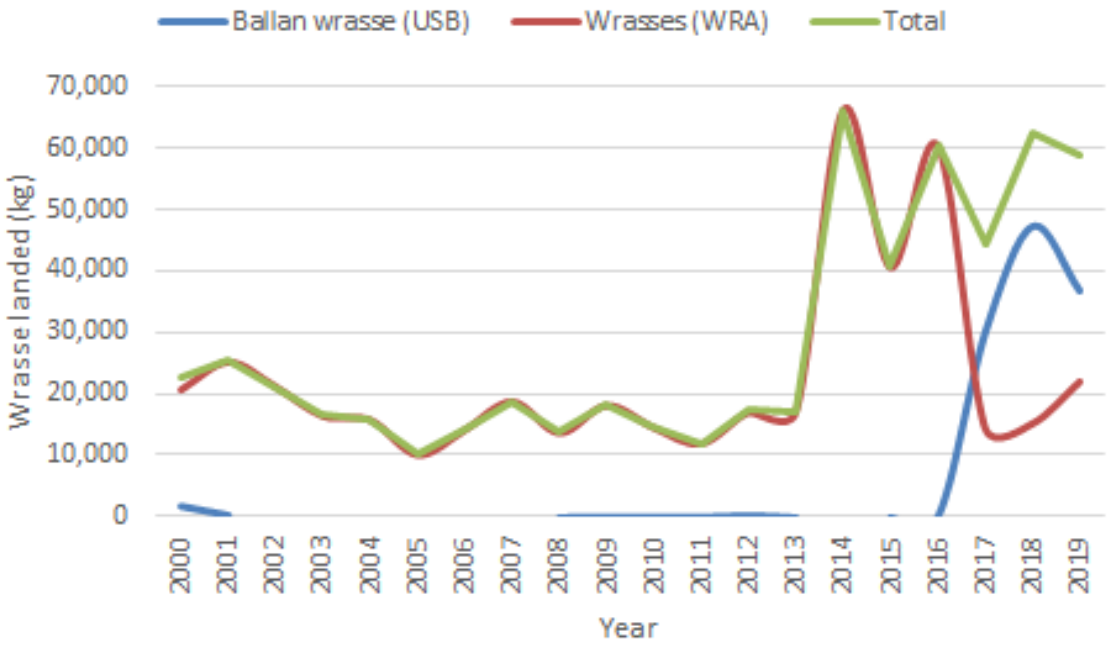


Figure 3. Wrasse landings (kg) by reporting category 2000–2019 (Data source: MMO [32] [33] [34]). Except Ballan wrasse, wrasses are not identified to species-level. (N.B. Data compiled from recorded landings from UK vessels into UK ports and foreign vessels into UK ports).

### 3.1.2 Lumpfish

Due to the behaviour of wrasse exhibiting winter dormancy and their inability to feed below 6°C, an alternative cleaner fish was sought. Wrasses limited use as cleaner fish over winter prompted interest into alternative cleaner fish that could remain active during winter and spring, the Lumpfish was identified as the species that offered the greatest potential. Lumpfish have the ability to feed at temperatures as low as 4°C and can be ready for deployment in salmon farms in as little as 4 months. Much sooner than Ballan wrasse which typically require 1.5 years. As a result, they are now the most commonly used cleaner fish species and their commercial production has risen exponentially in recent

[32] MMO (2020). UK Sea fisheries annual statistics report 2012 and landings data. Available at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2012 [Accessed 21.01.2020]
[33] MMO (2020). 2011 to 2015 landings data. Available for download at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2015 [Accessed 05.12.2020]
[34] MMO (2020). 2015 to 2019 landings data. Available for download at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2019 [Accessed 05.12.2020]

years.[35] In 2019, Norway farmed and sold 39.1 million juvenile Lumpfish.[36] The UK produced 1.9 million in 2016.[37]

Nearly all hatchery-reared Lumpfish derive from wild parents and as such pressure is put upon wild populations to supply the demand for broodstock.[38] [39] Fisheries for adult Lumpfish broodstock are developing in the United Kingdom and Ireland where no Lumpfish fisheries have previously existed.[40] Lumpfish rearing commenced in 2014 using eggs from wild-caught fish in Norway, Iceland, Ireland, Scotland and more recently in Canada. Lumpfish have also been reared from eggs stripped from wild fish caught in the English Channel, and shipped to a Scottish marine hatchery. Most eggs are obtained by catching fish from the wild and stripping them on receipt in the hatchery. There is concern for wild stocks and possible biosecurity risks of sourcing eggs from wild-caught fish, and thus a desire to move to use broodstock from hatchery reared production.[41] However, there have been no known efforts to close the life cycle of this species to end reliance on wild populations.

Stock movements represent an additional risk to wild Lumpfish as large numbers of hatchery-reared Lumpfish are being translocated across the North Atlantic to supply salmon farms, posing a potential threat to local populations. Over 85% of all Lumpfish deployed in Scotland during 2017 originated from eggs imported from Iceland and Norway, none came from local sources. In Ireland, 70% of Lumpfish deployed during 2015–2016 derived from eggs imported from Iceland and Norway.[42]Spawning stocks

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[35] Powell, A., Treasurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Cleaner fish for sea-lice control in salmon farming: Challenges and opportunities using lumpfish. *Reviews in Aquaculture.* 10, pp.683–702. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/raq.12194 [Accessed 25.08.2020]

[36] Norwegian Directorate of Fisheries (2020). Sale of farmed cleaner fish 2012-2019. Available from: http://fiskeridir.no/English/Aquaculture/Statistics/Other-marine-fish-species [Accessed 29.10.2020]

[37] Brooker, AJ., Papadopoulou, A., Gutierrez, C., Rey, S., Davie, A., Migaud, H. (2018). Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges. *Veterinary Record,* 183, 383. Doi: https://doi.org/10.1136/vr.104966. Available at https://dspace.stir.ac.uk/retrieve/0de65831-eb2c-44d5-b0ba-fb34006d8cbf/Brooker_2018%28CleanerFishReview%29.pdf [Accessed 26.08.2020]

[38] Saraiva, M., Beckmann, M., Pflaum, S., Pearson, M., Carcajona, D., Treasurer, J. and West, P. (2019). *Exophiala angulospora* infection in hatchery-reared lumpfish (*Cyclopterus lumpus*) broodstock. *Journal of Fish Diseases*, 42, pp.335-343. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/jfd.12940 [Accessed 03.09.2020]

[39] Powell, A., Treasurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Cleaner fish for sea-lice control in salmon farming: Challenges and opportunities using lumpfish. *Reviews in Aquaculture.* 10, pp.683–702. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/raq.12194 [Accessed 25.08.2020]

[40] Kennedy, J. *et al.*, (2018). A brief history of lumpfishing, assessment, and management across the North Atlantic. ICES Journal of Marine Science, doi:10.1093/icesjms/fsy146. Available at https://www.researchgate.net/publication/328601612_A_brief_history_of_lumpfishing_assessment_and_management_across_the_North_Atlantic [Accessed 21.10.2020]

[41] Saraiva, M., Beckmann, M., Pflaum, S., Pearson, M., Carcajona, D., Treasurer, J. and West, P. (2019). *Exophiala angulospora* infection in hatchery-reared lumpfish (*Cyclopterus lumpus*) broodstock. *Journal of Fish Diseases*, 42, pp.335-343. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/jfd.12940 [Accessed 03.09.2020]

[42] Whittaker, B., Consuegra, S. and Garcia de Leaniz, C. (2018). Genetic and phenotypic differentiation of lumpfish (*Cyclopterus lumpus*) across the North Atlantic: implications for conservation and aquaculture. PeerJ, 6, e5974. Doi: 10.7717/peerj.5974. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6251346/ [Accessed 26.08.2020]

have declined in Iceland and Canada and in the FAO assessment zone a 25-35% decline has been noted in the last 20 years.[43] [44]

A strong reduction in Catch Per Unit Effort (CPUE) has been detected in Lumpfish fisheries over the last 25 years. There are concerns that removing additional spawners for the expanding Lumpfish aquaculture industry could impact on some small populations, as it has been reported for other cleaner fish fisheries.[45] Some Lumpfish populations are very small and have low genetic diversity, which makes them particularly vulnerable to over-exploitation and genetic introgression (hybridisation).[46] In addition, male Lumpfish are particularly aggressive nest guarders, females can take up to 8 years to reach sexual maturity, and the species can live up to 13 years.[47]

Greenland has a regulated Lumpfish fishery managed by annual Total Allowable Catch (TAC) limits. In Iceland TACs for Lumpfish are only advisory but the Ministry have utilised a harvest strategy since 2014 and additional controls such as limiting days, boats and gear have been in place for many years. Norway do not operate TACs but regional ecosystem management plans exist.[48] Lumpfish fisheries elsewhere are largely unregulated despite there being a large demand for human consumption in the form of Lumpfish roe (a cheap alternative to traditional caviar) within Europe.[49] The Greenland Lumpfish fishery and the NFA Norwegian lumpish fishery is certified by the Marine Stewardship Council.[50]

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[43] Lorance, P., Cook, R., Herrera, J., de Sola, L., Florin, A. & Papaconstantinou, C. (2015). *Cyclopterus lumpus*. The IUCN Red List of Threatened Species 2015 e.T18237406A45078284. Available at http://www.iucnredlist.org/details/18237406/1 [Accessed 12.12.2020]

[44] Powell, A., Treasurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Use of lumpfish for sea-lice control in salmon farming: Challenges and opportunities. *Reviews in Aquaculture.* 10, pp.683–702. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/raq.12194 [Accessed 25.08.2020]

[45] Whittaker, B., Consuegra, S. and Garcia de Leaniz, C. (2018). Genetic and phenotypic differentiation of lumpfish (*Cyclopterus lumpus*) across the North Atlantic: implications for conservation and aquaculture. PeerJ, 6, e5974. Doi: 10.7717/peerj.5974. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6251346/ [Accessed 26.08.2020]

[46] Whittaker, B., Consuegra, S. and Garcia de Leaniz, C. (2018). Genetic and phenotypic differentiation of lumpfish (*Cyclopterus lumpus*) across the North Atlantic: implications for conservation and aquaculture. PeerJ, 6, e5974. Doi: 10.7717/peerj.5974. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6251346/ [Accessed 26.08.2020]

[47] Froese, R. and Luna, S. (2020). Cyclopterus lumpus. Available at https://www.fishbase.in/summary/Cyclopterus-lumpus [Accessed 29.10.2020]

[48] MCS (2020). Track a Fishery: Lumpfish. Available at https://fisheries.msc.org/en/fisheries/@@search?q=lumpfish&search= [Accessed 29.10.2020]

[49] Whittaker, B., Consuegra, S. and Garcia de Leaniz, C. (2018). Genetic and phenotypic differentiation of lumpfish (*Cyclopterus lumpus*) across the North Atlantic: implications for conservation and aquaculture. PeerJ, 6, e5974. Doi: 10.7717/peerj.5974. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6251346/ [Accessed 26.08.2020]

[50] MCS (2020). Track a Fishery: Lumpfish. Available at https://fisheries.msc.org/en/fisheries/@@search?q=lumpfish&search= [Accessed 29.10.2020]

The UK has seen a 92.5% reduction in Lumpfish landings from 2013 to 2019 (Figure 4). This may highlight a relatively low requirement for wild-caught Lumpfish because of successful hatchery production.[51] Nonetheless, reduced catches can also be an indicator of population declines in some cases.

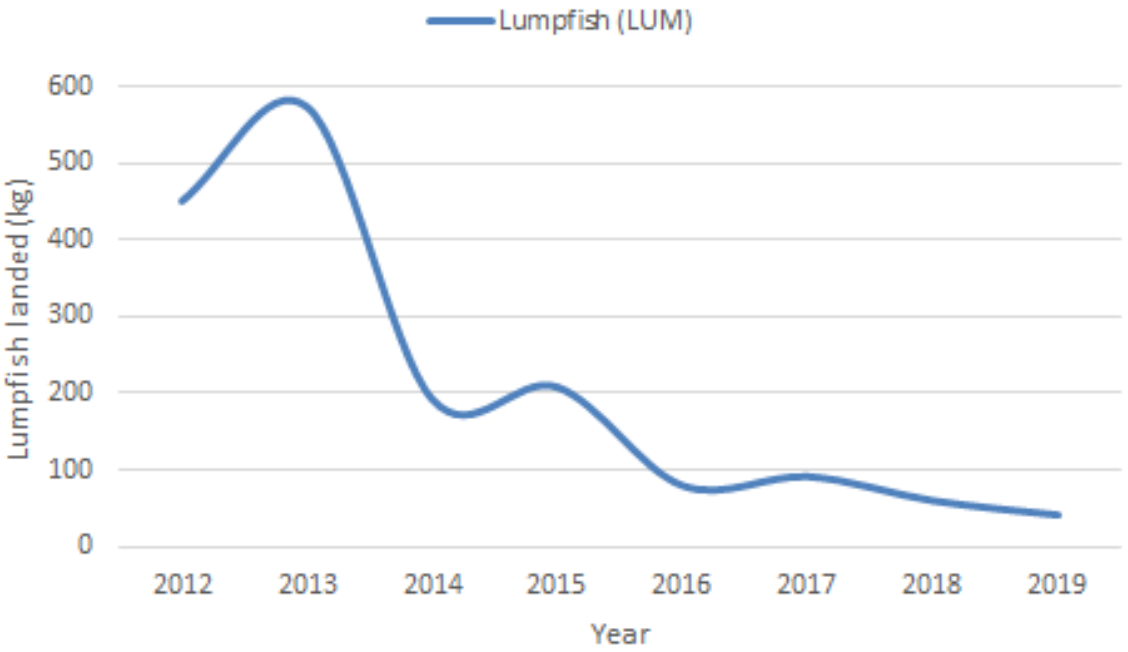


Figure 4. Lumpfish landings (kg) by reporting category 2012–2019 (Data source: MMO [52] [53]). (N.B. Data compiled from recorded landings from UK vessels into UK ports and foreign vessels into UK ports).

## 3.2 Farmed cleaner fish

The increasing demand for cleaner fish has resulted in an intensification of aquaculture of Ballan wrasse and particularly Lumpfish as they are proving to be the least challenging in terms of hatchery production.[54] It had been envisaged that all cleaner fish requirements would be met by farmed sources by 2019.[55] This has not, as yet, been achieved and aquaculture operations will need to intensify further to fulfil demand.

[51] MOWI (2021). Bumper year for cleaner fish. The Scoop, January 2021 Issue.
[52] MMO (2020). 2011 to 2015 landings data. Available for download at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2015 [Accessed 05.12.2020]
[53] MMO (2020). 2015 to 2019 landings data. Available for download at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2019 [Accessed 05.12.2020]
[54] Brooker, AJ., Papadopoulou, A., Gutierrez, C., Rey, S., Davie, A., Migaud, H. (2018). Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges. *Veterinary Record,* 183, 383. Available at https://dspace.stir.ac.uk/retrieve/0de65831-eb2c-44d5-b0ba-fb34006d8cbf/Brooker_2018%28CleanerFishReview%29.pdf [Accessed 26.08.2020]
[55] Devon and Severn IFCA (2017). Live Wrasse Press Release. Available at https://secure.toolkitfiles.co.uk/clients/15340/sitedata/Wrasse/Live-Wrasse-Press-Release-Final-NJT-edit.pdf [Accessed 22.08.2017]

Farmed cleaner fish, whilst not having the fishery management concerns associated with their wild capture counterparts, are not without their own concerns. These include:

- Hatcheries for both wrasse and Lumpfish rely on wild-caught broodstock for production, with all the associated issues discussed above.[56] [57]
- Gaps in technical understanding and research in cleaner fish aquaculture, including but not limited to diet formulation. Responsible feed sourcing is also essential.
- Implications of escaped farmed cleaner fish on wild populations and ecological consequences from this remains largely unknown.
    - Studies have indicated that escaped wrasse cleaner fish (of farmed origin) have been known to hybridize with wild wrasse populations, causing genetic dilution.[58] [59] [60]
    - Escapes of Lumpfish are rare but the genetic impact on local Lumpfish populations may still occur depending on the number of escapees, their reproductive success, and the extent of genetic differentiation between local and introduced fish. However, none of these parameters are currently known for this species.[61]

  The result of escapes may lead to further exacerbating declines in the abundance of wild populations.
- There is a risk that hatchery reared cleaner fish may transfer disease to wild populations post-deployment.[62] [63]

[56] Davies, P. and Sheehan, E. (2019). Laser chasing behaviour of wild fishes exploited as a tool to compare space use between size, sex and species. Journal of Applied Ichthyology, 35(6), pp. 1225-1233. Available at https://doi.org/10.1111/jai.13982 [Accessed 23.09.2020]

[57] Powell, A., Treasurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Use of lumpfish for sea-lice control in salmon farming: Challenges and opportunities. *Reviews in Aquaculture.* 10, pp.683–702. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/raq.12194 [Accessed 25.08.2020]

[58] Faust E. *et al*. (2018). Faust E, Halvorsen KT, Andersen P, Knutsen H, André C. Cleaner fish escape salmon farms and hybridize with local wrasse populations. Royal Society Open Science. 5:171752. doi: 10.1098/rsos.171752.

[59] Gonzalez, E., Espeland, S., Jentoft, S., Hansen, M., Robalo, J., Stenseth, N. and Jorde, P. (2019). Interbreeding between local and translocated populations of a cleaner fish in an experimental mesocosm predicts risk of disrupted local adaptation. Ecology and Evolution, 9(11), pp.6665-6677. Available at https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.5246 [Access 23.06.2020]

[60] Whittaker, B., Consuegra, S. and Garcia de Leaniz, C. (2018). Genetic and phenotypic differentiation of lumpfish (*Cyclopterus lumpus*) across the North Atlantic: implications for conservation and aquaculture. PeerJ, 6, e5974. Doi: 10.7717/peerj.5974. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6251346/ [Accessed 26.08.2020]

[61] Whittaker, B., Consuegra, S. and Garcia de Leaniz, C. (2018). Genetic and phenotypic differentiation of lumpfish (*Cyclopterus lumpus*) across the North Atlantic: implications for conservation and aquaculture. PeerJ, 6, e5974. Doi: 10.7717/peerj.5974. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6251346/ [Accessed 26.08.2020]

[62] Fletcher, R. (2018). New pathogen discovered in lumpfish. Available at https://thefishsite.com/articles/new-pathogen-discovered-in-lumpfish [Accessed 03.09.2020]

[63] Powell, A., Treasurer, J., Pooley, C., Keay, A., Lloyd, R., Imsland, A. and Garcia de Leaniz, C. (2018). Use of lumpfish for sea-lice control in salmon farming: Challenges and opportunities. *Reviews in Aquaculture.* 10, pp.683–702. Available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/raq.12194 [Accessed 25.08.2020]

# 4.0 Fisheries management

Cleaner fish fisheries are largely unregulated. In the United Kingdom catches are not restricted and no annual Total Allowable Catch limits are set, unlike most other commercial fisheries.

There is no statutory minimum landing size for Lumpfish or wrasses caught within the United Kingdom. Without appropriate minimum landing sizes in place for cleaner fish species, based on size at sexual maturity, the fish do not have the opportunity to breed before retention.[64] [65]

## 4.1 Lumpfish

In addition to the fishery for roe, a fishery for adult broodstock has recently developed in the United Kingdom (where no significant Lumpfish fishery existed previously). The fishery is targeting mature individuals to be used as broodstock to product juvenile Lumpfish, for salmon aquaculture.[66] MMO landings data (2012-2019) displays Lumpfish landings from English, Scottish and Welsh waters. However, it appears that any directed UK Lumpfish fisheries are located within the south and south-west of England. Reported landings of Lumpfish from Scotland and the east coast of England have declined considerably between 2012 and 2019.

There is currently no known management for, or monitoring of, Lumpfish in the United Kingdom. Introduction of fisheries management measures is essential for Lumpfish, particularly as the species has low resilience and moderate to high vulnerability to fishing pressures[67], 'Near Threatened' status by the IUCN Red List of Threatened Species, are displaying abundance declines within Europe, and with increasing demand as a preferred cleaner fish species, for its use within aquaculture.

## 4.2 Wrasse

Although some management measures are in place for wrasse fisheries within the United Kingdom, there are concerns over the opening seasons of these fisheries. Open seasons overlap with the spawning/breeding season of all five commercially important wrasse species (see Table 1). This may affect spawning populations and recruitment. Moreover, many of the minimum landing sizes applied to wrasse species in the various management regions are not appropriate. The size at which wrasses mature (Table 1) is often larger than that of the minimum catch size employed by management rules. Consequently, wrasse species may be caught before they have had the chance to reproduce.

[64] NIFCA (2020). Minimum sizes. Available at https://www.nifca.gov.uk/minimum-sizes/ [Accessed 19.10.2020]
[65] British Sea Fishing (2020). Lumpsucker. Available at https://britishseafishing.co.uk/lumpsucker/ [Accessed 21.10.2020]
[66] Kennedy, J. *et al.*, (2018). A brief history of lumpfishing, assessment, and management across the North Atlantic. ICES Journal of Marine Science, doi:10.1093/icesjms/fsy146. Available at https://www.researchgate.net/publication/328601612_A_brief_history_of_lumpfishing_assessment_and_management_across_the_North_Atlantic [Accessed 21.10.2020]
[67] Froese, R. and Luna, S. (2020). Cyclopterus lumpus. Available at https://www.fishbase.in/summary/Cyclopterus-lumpus [Accessed 29.10.2020]

### 4.2.1 Scotland

Historically, wrasse species were not targeted by Scottish fishermen on a commercial scale. However, in recent years, effort in the wrasse fishery has increased dramatically to fulfil the growing demand from the salmon aquaculture industry.[68]

In August 2017 a Freedom of Information request was submitted to Marine Scotland (of the Scottish government)[69] to ascertain exact numbers of wrasse caught and bought; species identification; capture area and mortalities of cleaner fish used in Scottish Atlantic salmon farming. None of this information was available as it is not collected or recorded. However, Marine Scotland were able to state that 1.5 million farmed cleaner fish were used in Scottish aquaculture in 2016.

In May 2018, the Scottish Government introduced Voluntary Control Measures for Live Capture of Wild Wrasse for Scottish Salmon Farms[70] to manage the wrasse fishery, working with Scottish Salmon Producers Organisation (SSPO). In addition to voluntary input (effort) and output (catch) controls, and other technical measures (listed below) the agreed voluntary control measures requested fishers to:

- Adhere to specifications designed to protect fish welfare and improve mortality rates (i.e., Code of Good Practice for Scottish Finfish Aquaculture, and RSPCA Assured standards).
- Support information and data gathering: maintaining records of numbers, linked to weights of wrasse caught and reported. Supplying information on number of undersized and over-sized fish returned, by species for the first 20 traps deployed each week (see Table 2), with reference to location, total pots hauled, total weight by species.
- Contribute to science and research: e.g., identification of spawning areas and times to ensure protection of caught species during peak breeding activity.

Following calls for the implementation of more stringent management measures Marine Scotland undertook an internal review of the voluntary measures. In response to the internal review a public consultation was launched (11th March to 10th May 2020) on the introduction of mandatory measures to control the harvesting of live wrasse for the salmon farming industry, via a new permit scheme which would set conditions for participating in the fishery.[71] [72] The proposed mandatory fishing measures, which were agreed upon and formalised, included the original voluntary measures in addition to the

[68] SIFT (2020). Wrasse Consultation Guidance SIFT. Available at https://www.sift.scot/wp-content/uploads/2020/04/Wrasse-Consultation-Guidance-SIFT.pdf [Accessed 26.10.2020]

[69] FOI request. Open Seas to Marine Scotland. 20th July 2017.

[70] Scottish Government (2020). Wild Wrasse Harvesting Consultation on Proposed new Mandatory Fishing Measures: March 2020. Available at https://www.gov.scot/binaries/content/documents/govscot/publications/consultation-paper/2020/03/wild-wrasse-harvesting-consultation-proposed-new-mandatory-fishing-measures/documents/wild-wrasse-harvesting-consultation-proposed-new-mandatory-fishing-measures/wild-wrasse-harvesting-consultation-proposed-new-mandatory-fishing-measures/govscot%3Adocument/wild-wrasse-harvesting-consultation-proposed-new-mandatory-fishing-measures.pdf [Accessed 26.10.2020]

[71] Scottish Government (2020). Wild Wrasse Harvesting: Consultation. Available at https://www.gov.scot/publications/wild-wrasse-harvesting-consultation-proposed-new-mandatory-fishing-measures/pages/1/ [Accessed 26.10.2020]

[72] Scottish Government (2020). Wild Wrasse Harvesting: Consultation on Proposed new Mandatory Fishing Measures. Available at https://consult.gov.scot/marine-scotland/wild-wrasse-harvesting/ [Accessed 26.10.2020]

requirement for fishers to accept observers if requested and to have Remote Electronic Monitoring (REM), or other appropriate inshore vessel monitoring if requested. Licence eligibility requires fishers to provide a track record of fishing wrasse with creels in the 12 months prior to 10 March 2020.[73]

### Input (effort) controls

The maximum use of 250 creels per vessel.

Controls over the design and deployment of traps/creels:

- Only creels specifically designed can be used to target and catch wrasse, and ensure wrasse welfare.
- Otter exclusion devices (e.g., fixed-eye aperture) to be used at the entrance of the traps and creels must feature escape hatches.

Creels will be lifted at a maximum 6 metres per minute.

Creels should not be lifted when the water temperature is >17 degrees C.

### Output (catch) controls

Minimum and Maximum landing sizes:

- Small species, i.e., Goldsinny wrasse (*Ctenolabrus rupestris*), Rock cook wrasse (*Centrolabrus exoletus*) and Corkwing wrasse (*Symphodus melops*): 12-17cm.
- Large species, i.e., Ballan wrasse (*Labrus bergylta*) and Cuckoo wrasse (*Labrus mixtus*): 12-24cm.

### Other technical measures

Closed season: 1st December – 1st May.

[73] The Scottish Government (2020). Wild wrasse harvesting - proposed mandatory fishing measures: consultation analysis. 03 December 2020. Available at https://www.gov.scot/publications/analysis-responses-consultation-proposed-new-mandatory-fishing-measures-wild-wrasse-harvesting/pages/1/ [Accessed 17.12.2020]

Table 2. Summary of 2018 and 2019 Scottish wild caught wrasse data, based on first 20 traps lifted each week by each boat (Data source: SSPO[74] [75]).

| Number of wrasse in first 20 traps lifted weekly | Undersize | Target | Oversize | Total |
|---|---|---|---|---|
| *Ballan* | | | | |
| *2018* | | | | |
| Number | 1130 | 3187 | 573 | 4890 |
| % | 23.11 | 65.17 | 11.72 | |
| *2019* | | | | |
| Number | 3062 | 7102 | 1747 | 11911 |
| % | 25.7 | 59.6 | 14.7 | 22.6 |
| *Corkwing* | | | | |
| *2018* | | | | |
| Number | 2458 | 2306 | 380 | 5144 |
| % | 47.78 | 44.83 | 7.39 | |
| *2019* | | | | |
| Number | 3438 | 4901 | 399 | 8738 |
| % | 39.3 | 56.1 | 4.6 | 16.6 |
| *Cuckoo* | | | | |
| *2018* | | | | |
| Number | 1107 | 1315 | 436 | 2858 |
| % | 38.73 | 46.01 | 15.26 | |
| *2019* | | | | |
| Number | 2230 | 2566 | 248 | 5044 |
| % | 44.2 | 50.9 | 4.9 | 9.6 |
| *Goldsinny* | | | | |
| *2018* | | | | |
| Number | 5801 | 4759 | 104 | 10664 |
| % | 54.40 | 44.63 | 0.98 | |
| *2019* | | | | |
| Number | 6516 | 7811 | 18 | 14345 |
| % | 45.4 | 54.5 | 0.1 | 27.2 |
| *Rock cook* | | | | |
| *2018* | | | | |
| Number | 4290 | 2684 | 34 | 7008 |
| % | 61.22 | 38.30 | 0.49 | |
| *2019* | | | | |
| Number | 6107 | 6481 | 19 | 12607 |
| % | 48.4 | 51.4 | 0.2 | 23.9 |
| *All wrasse* | | | | |
| *2018* | | | | |

[74] SSPO (2020). Summary data for 2018 wild catch of wrasse. Available at https://www.scottishsalmon.co.uk/resource-centre/infographics/summary-data-for-2018-wild-catch-of-wrasse [Accessed 21.01.2020]

[75] SSPO (2020). Summary data for 2019 wild catch of wrasse. Available at https://www.scottishsalmon.co.uk/reports/summary-data-for-2019-wild-catch-of-wrasse [Accessed 21.01.2021]

| | | | | |
|---|---|---|---|---|
| Total | 14786 | 14251 | 1527 | 30564 |
| % | 48.38 | 46.63 | 5.00 | |
| *2019* | | | | |
| Total | 21353 | 28861 | 2431 | 52645 |
| % | 40.6 | 54.8 | 4.6 | |

### 4.2.2 England

The south-west of England is where the wrasse fisheries are located. These fishing areas are under the jurisdiction of the local Inshore Fisheries and Conservation Authorities (IFCAs). Landings of wrasse have also been documented in the eastern English regions where no inshore management for wrasse currently exists. It is suggested that the increasing exploitation and shipping of live wrasse from the South West of England to Scotland, is only necessary because localised Scottish wrasse stocks have already been depleted by the demand from salmon farms.[76]

In recent years the south and south west IFCAs (Cornwall; Devon and Severn; and Southern) have developed a variety of management proposals to manage the wrasse fisheries. However, the sustainability of the use of wild wrasse captured from England in Scottish salmon farms remains unclear.

#### 4.2.2.1 Southern IFCA

Southern IFCA introduced Wrasse Fishery Guidance in July 2017.[77] In summary this guidance document prescribes the following requirements for anyone commercially fishing wrasse:

**Input (effort) controls**

The maximum use of 80 pots per vessel.

**Output (catch) controls**

Minimum and Maximum Conservation Reference Sizes:

- Ballan wrasse (*Labrus bergylta*): 18-28cm; Corkwing wrasse (*Symphodus melops*): 14-22cm; Rock cook wrasse (*Centrolabrus exoletus*) and Goldsinny wrasse (*Ctenolabrus rupestris*): 12-18cm.
- Live Cuckoo wrasse (*Labrus mixtus*) must be returned to the fishery immediately.

**Other technical measures**

Closed season: 1st April – 30th June.

Closed areas: no take zones for commercial wrasse fishing in certain coastal areas.

Maximum fishing depth: 10 metres.

[76] Angling Trust (2020). Save our Wrasse. Available at https://anglingtrust.net/save-our-wrasse/ [Accessed 19.10.2020]

[77] Southern IFCA. 2017. Wrasse Fishery Guidance. Available at https://secure.toolkitfiles.co.uk/clients/25364/sitedata/files/Wrasse-Guidance.pdf [Accessed 22.08.2017]

Catch data (registration of wrasse buyers, and monthly catch returns detailing the quantities of species caught, fishing locations and fishing effort) is required, in addition to biosecurity and husbandry measures to prevent the mixing of genetic structure and the transport of disease, parasites and non-native species.

#### 4.2.2.2 Devon and Severn IFCA

Devon and Severn IFCA also introduced fisheries management measures in 2017 for the live wrasse fishery,[78] via the Potting Permit Byelaw. These early management measures were largely based on best practice identified in the literature and included minimum and maximum Conservation References Sizes (CRS), a closed season and a cap on effort. A fully documented fishery was also implemented and as such an intensive data collection programme has been conducted since 2017, consisting of on-board observer surveys and fishers' landings forms. A review of the fishery for the 2017–2019 period has since been undertaken.[79] A formal consultation was published for proposed amendments to the permit conditions, which closed 15th May 2020, to manage the live wrasse pot fishery. As of 10th July 2020, key changes resulting from the consultation came into force. These included: the removal of Rock cook wrasse from a fishery within the District is now prohibited and the CRS for Rock cook wrasse removed from the Potting Permit Conditions; a schedule was added to assist permit holders measuring their catch in accordance with the Potting Permit Conditions; and Policy and Guidance for the Live Wrasse Pot Fishery was updated.[80] [81] Measures in place under the revised Devon and Seven IFCA Potting Permit include:

Input (effort) controls

The maximum use of 120 pots per permit holder.

- All strings of pots used in the Live Wrasse Fishery are marked with 'WRA' and the vessel's PLN, and each pot is fitted with a tag supplied by the IFCA.

Output (catch) controls

Minimum and Maximum landing sizes:

- Ballan wrasse (*Labrus bergylta*): 15-23cm; Corkwing wrasse (*Symphodus melops*): 14-18cm; Goldsinny wrasse (*Ctenolabrus rupestris*): 12-23cm; Cuckoo wrasse (*Labrus mixtus*): 15-23cm.

[78] Devon and Severn IFCA. 2017. Live Wrasse Press Release. Available at https://secure.toolkitfiles.co.uk/clients/15340/sitedata/Wrasse/Live-Wrasse-Press-Release-Final-NJT-edit.pdf [Accessed 22.08.2017]

[79] Curtin, S., Henley, L. and Stewart, J. (2020). Three Year Comprehensive Review of the Live Wrasse Fishery in Devon and Severn IFCA's District, April 2020. D&S IFCA, pp.4-54.

[80] DSIFCA (2020). Potting Permit Byelaw: Policy Statement & Potting Permit Conditions for the Live Wrasse Fishery. D&S IFCA Policy Document 24th June 2020, pp.1-4. Available for download at https://www.devonandsevernifca.gov.uk/Enforcement-Legislation/Current-Permit-Byelaws-Permit-Conditions [Downloaded 21st October 2020]

[81] Townsend, N. (2020). Potting Permit Byelaw: Development and Management of the Live Wrasse Pot Fishery & Changes to the Potting Permit Conditions. Process and Decision Making for the Three-Year Comprehensive Review of the Live Wrasse Pot Fishery 2020 Final Report: 18th August 2020. D&S IFCA, pp.3-57.

- The removal of Rock cook wrasse (*Centrolabrus exoletus*) is prohibited.

**Other technical measures**

Closed season: 1st May – 15th July.

Closed areas: a series of small voluntary closed zones, known as 'No Wrasse Pot Zones'.

Devon and Severn IFCA have introduced a Fully Documented Live Wrasse Fishery. In order to manage the Live Wrasse Pot Fishery, and as part of the fully documented fishery, fishers are required to monitor fishing effort and provide weekly catch returns. This must detail information on the dates and times of hauling, location of strings, number of strings hauled, number of pots hauled, and the number of wrasse retained on board, per day.

#### 4.2.2.3 Cornwall IFCA

Cornwall IFCA introduced a permit system in 2018, under the Live Wrasse Fishing (Limited Permit) Byelaw 2018,[82] [83] comprising:

**Input (effort) controls**

Gear restrictions

- Pots and traps used for wrasse fishing limited to a maximum length of 75cm, width of 45cm and depth of 35cm.
- Gears must have a ridged entrance of a maximum diameter of 9cm.
- Gears must encompass two escape gaps at least 7cm in height and 1cm in width.

**Output (catch) controls**

Minimum Landing Sizes:

- Ballan wrasse (*Labrus bergylta*): 16cm; Corkwing wrasse (*Symphodus melops*), Rock cook wrasse (*Centrolabrus exoletus*) and Goldsinny wrasse (*Ctenolabrus rupestris*): 12cm.
- Live Cuckoo wrasse (*Labrus mixtus*) must be returned to the fishery immediately.

**Other technical measures**

Closed season for Ballan wrasse: 1st January – 31st March.

Closed season for Goldsinny, Rock cook and Corkwing wrasses: 1st May – 30th June.

Closed areas for commercial wrasse fishing in 'prohibited areas'.

[82] Cornwall IFCA (2018). Live Wrasse Fishing (Limited Permit) Byelaw 2018. Available at https://secure.toolkitfiles.co.uk/clients/17099/sitedata/Byelaws%20and%20orders/Cornwall_IFCA/Live-Wrasse-Fishing-Byelaw-2018.pdf [Accessed 19.10.2020]

[83] Cornwall IFCA (2020). Live Wrasse Fishery. Available at https://www.cornwall-ifca.gov.uk/live-wrasse-fishery [Accessed 19.10.2020]

### 4.2.3 Wales

In 2017 and 2018, no live wrasse was purchased from Wales to supply the salmon farming industry in Scotland with 'cleaner fish'. Wrasse were however considered to be an emerging fishery within Wales, as detailed within Wales Marine Fisheries Advisory Group (WMFAG) progress report.[84] The government decided to assess the wild capture activity and potential demand from aquaculture sector, and considered the development of a Code of Practice dependant on the level of activity and the business plans of the salmon farming industry. However, with Marine Harvest's (now Mowi) development of a wrasse breeding system, in Wales, the government considered this development likely to eliminate or dramatically reduce the salmon farming industry's reliance on wild caught fish in future.

At present, the situation remains as it was in 2018 and there has been no known trade of live wrasse caught in, or purchased from, Welsh waters to supply the salmon farming industry in 2019 or 2020. Nonetheless, the government intends to maintain communications with the salmon farming industry representatives. To establish if there are likely to be any changes in demand and to keep a watching brief on the potential for this fishery.[85]

### 4.2.4 Northern Ireland

No known research has been undertaken to date on the scale of the wrasse fishery or the impact of wrasse fishing in Northern Ireland, on local wrasse populations.

Table 3. Summary of cleaner fish management measures in the United Kingdom.

| | Management measure (*voluntary *V* / mandatory *M*) | | | | | | |
|---|---|---|---|---|---|---|---|
| Area | TAC or quotas | Minimum and Maximum landing size(s) | Effort Controls | Gear restrictions | Closed areas | Closed seasons | Monitoring of fishery |
| Wrasse spp. | | | | | | | |
| England (**V and *M***) | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Scotland ***(M)*** | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Wales | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Northern Ireland | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Lumpfish | | | | | | | |
| United Kingdom | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |

[84] WMFAG (2018). Wales Marine Fisheries Advisory Group Summary or Key Work-streams: 7th February 2019. WMFAG - (M1) - Item 5, pp.1-12. Available at https://gov.wales/sites/default/files/publications/2019-03/wales-marine-fisheries-advisory-group-summary-of-key-workstreams.pdf [Accessed 26.10.2020]

[85] Personal communication (28th October 2020). Welsh Government, Marine and Fisheries Division.

# 5.0 Cleaner fish health and welfare

Gaps in knowledge surrounding cleaner fish welfare on salmon farms (e.g., key causes of mortality of cleaner fish on salmon farms; the best form of supplementary food and feeding mechanism; health issues, for example the impact of sea lice on cleaner fish, and the potential of disease spread between cleaner fish and salmon) has led to compromised cleaner fish welfare.[86] The industry must be able to demonstrate that there are appropriate provisions in place for the health and welfare of Lumpfish and wrasse used as cleaner fish on salmon farms to ensure fish are adequately safeguarded.

There are a number of issues of concern regarding the post capture; storage and transport of wild caught live wrasse (i.e., gravid fish; undersized fish; species aggression; bacterial disease; skin and gill parasite and physical damage due to poor handling at the quayside). High stocking densities in holding sites can also result in mortalities, which can create an environment for disease amongst the remaining fish. Some fish can carry disease prior to entering the facilities, indicating that diseases are present in wild fish prior to capture. The subsequent holding in high stocking densities in enclosed systems could potentially amplify this issue.[87]

It is also essential to ensure that humane slaughter methods are in place for cleaner fish as well as for the farmed salmon.

## 5.1 Development of detailed, species-specific welfare standards

There is a lack of standards available to help safeguard cleaner fish welfare. No stand-alone standards exist for cleaner fish, though they are mentioned in standards that apply to salmon farming in the UK, including RSPCA Assured, the Code of Good Practice for Scottish Finfish Aquaculture, and Soil Association. It is possible to have more detailed species-specific welfare standards, which cover the whole life cycle of lumpsuckers and Ballan wrasse. For example, the Norwegian Seafood Research Fund (FHF) cleaner fish guidelines.[88] There is a need for standards to be developed that cover the whole life cycle of farmed and wild-caught cleaner fish. The standards should account for species-specific differences between Ballan wrasse (and, if appropriate, other wrasse species) and Lumpfish. In addition to stand-alone cleaner fish welfare standards, welfare standards relating to farmed salmon should include detailed cleaner fish standards. The development and standardisation of best management practices and routine health checks minimise disease and maintain a good welfare status.

It is important that any revisions to available standards applicable to cleaner fish or the development of any new standards (e.g., RSPCA cleaner fish welfare standard) are finalised and published as soon as possible. Any data being sourced for standard developments should be gathered within a realistic but timely manner in order to achieve this. The RSPCA has been collecting information concerning the welfare implications of sourcing wild caught versus hatchery reared cleaner fish. This information will

[86] OneKind (2018). CLEANER FISH WELFARE ON SCOTLAND'S SALMON FARMS: A REPORT BY ONEKIND, pp.1-23. Available at https://www.onekind.scot/wp-content/uploads/cleaner-fish-report-final-low-res.pdf [Accessed 29.10.2020]

[87] Callaghan, A & Pering, D. 2016. Wrasse Cleanerfish Project Report. Native Marine Centre.

[88] FHF (2017). CLEANERFISH – BEST PRACTICE GUIDELINES FROM THE NORWEGIAN SEAFOOD RESEARCH FUND (FHF). pp.1-62. Available at https://www.scottishaquaculture.com/media/1470/fhf-cleanerfish-guidelines.pdf [Accessed 25.09.2020]

be used to inform the development of future standards, which may only permit the sourcing of hatchery reared cleaner fish.[89] RSPCA Assured now have over 70 percent of Scottish salmon farms signed up to their welfare scheme, with RSPCA standards for wrasse and Lumpfish welfare currently under development.[90]

## 5.2 Use of Operational Welfare Indicators (OWIs)

To monitor health and welfare both in hatcheries and following deployment at sea, Operational Welfare Indicators (OWI) must be defined for each cleaner fish species. OWI's should be based on preferred environmental conditions, physical and physiological status or behaviour.[91] Environment based OWIs are well established indirect welfare indicators for numerous farmed species. Although information may be more limited for cleaner fish species in comparison to other farmed species, the best available data on OWIs for wrasse (e.g., Noble *et al*., 2019[92]) and Lumpfish (e.g., Rabadan *et al*., 2020[93]; Eliasen *et al*., 2020[94]) at all stages of their development, should be considered within the farming operations of cleaner fish.

[89] RSPCA (2018). RSPCA Welfare Standards for Farmed Atlantic Salmon. Available at https://science.rspca.org.uk/documents/1494935/9042554/RSPCA+welfare+standards+for+farmed+Atlantic+salmon+%28PDF+2.56MB%29.pdf/60ae55ee-7e92-78f9-ab71-ffb08c846caa?t=1557668417384 [Accessed 20.10.2020]

[90] Blamforth, N. (2019). Fish welfare in the spotlight. Available at https://thefishsite.com/articles/fish-welfare-in-swanseas-spotlight [Accessed 24.09.2020]

[91] Brooker, A.J., Papadopoulou, A., Gutierrez, C., Rey, S., Davie, A. and Migaud, H. (2018). Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges. *Veterinary Record,* 183, 383. doi: https://doi.org/10.1136/vr.104966. Available at https://dspace.stir.ac.uk/retrieve/0de65831-eb2c-44d5-b0ba-fb34006d8cbf/Brooker_2018%28CleanerFishReview%29.pdf [Accessed 25.08.2020]

[92] Noble, C., Iversen, M. H., Lein, I., Kolarevic, J., Johansen, L. –H., Burgerhout, E., Puvanendran, V., Kousoulaki, K., Aas, G. H., Stene, A. & Espmark, Å. M. (2019). RENSVEL OWI FACT SHEET SERIES: An introduction to Operational and Laboratory based Welfare Indicators for ballan wrasse (Labrus bergylta). 43 pp. Available at https://nofima.no/wp-content/uploads/2019/10/RENSVEL-ballan-wrasse-OWI-factsheet-series-v1.0-14.05.2019.pdf [Accessed 24.09.2020]

[93] Rabadan, C., Spreadbury, C., Consuegra, S. and Leaniz, G. (2020). Development, validation and testing of an Operational Welfare Score Index for farmed lumpfish *Cyclopterus lumpus* L. Aquaculture, 531(735777). Doi: https://doi.org/10.1016/j.aquaculture.2020.735777 [Accessed 04.09.2020]

[94] Eliasen, K., Patursson, E., McAdam, B., Pino, E., Morro, B., Betancor, M., Baily, J. and Rey, S. (2020). Liver colour scoring index, carotenoids and lipid content assessment as a proxy for lumpfish (Cyclopterus lumpus L.) health and welfare condition. Scientific Reports, 10(8927). Available at https://www.nature.com/articles/s41598-020-65535-7 [Accessed 04.09.2020]

## 6.0 Post harvest

Currently there is no post-harvest use of cleaner fish,[95] which results in a significant waste of fish protein. When applying a conservative figure of 50g (deployment weight of Ballan wrasse[96] [97]) and multiplying it by the estimated 60 million cleaner fish used annually in salmon farms, this equates to 3,000 tonnes of wasted protein. However, this figure is likely to be significantly higher due to mortalities and weight at harvest being much higher. If a market for human consumption cannot be developed this fish protein should at least be converted into fishmeal.

[95] OneKind (2018). CLEANER FISH WELFARE ON SCOTLAND'S SALMON FARMS: A REPORT BY ONEKIND, pp.1-23. Available at https://www.onekind.scot/wp-content/uploads/cleaner-fish-report-final-low-res.pdf [Accessed 29.10.2020]

[96] Brooker, A.J., Papadopoulou, A., Gutierrez, C., Rey, S., Davie, A. and Migaud, H. (2018). Sustainable production and use of cleaner fish for the biological control of sea lice: recent advances and current challenges. *Veterinary Record,* 183, 383. Available at https://dspace.stir.ac.uk/retrieve/0de65831-eb2c-44d5-b0ba-fb34006d8cbf/Brooker_2018%28CleanerFishReview%29.pdf [Accessed 25.08.2020]

[97] Helland, S., Dahle, S. W., Hough, C. and Borthen, J. (2014). Production of Ballan Wrasse (*Labrus bergylta*). Science and Practice. The Norwegian Seafood Research Fund (FHF), 136 pp.

# 7.0 Conclusion

Aquaculture production is predicted to grow with the potential to achieve up to 300-400,000 tonnes by 2030.[98] Most of which is likely to be Atlantic salmon. With production continuing to occur in open water cages, sea lice management will remain an issue for not only the health and welfare of the farmed salmon but also for wild salmonids, and the economic performance of the salmon farms themselves.

Chemical organophosphate sea lice treatments are becoming less effective as sensitivity to active ingredients decreases, resulting in a need to find non-chemical sea lice control solutions. Cleaner fish are one solution that is proving effective and popular in Scotland and Norway. However, this is resulting in the decimation of local populations of wild caught fish.

Fisheries management measures are essential to halt the decline of wild stocks and need to be implemented in all areas where fisheries occur. Until the implementation of appropriate management measures which have been developed from the sound understanding and research of species biological characteristics and stock status, neither wild wrasse or Lumpfish fisheries can claim to be sustainable, or responsibly managed. Management measures need to be integrated into regulation rather than remaining as guidance or voluntary measures, to ensure they can be fully implemented and enforced.

Farming of cleaner fish is expanding to supply the increasing demand from the salmon farming sector. This cannot be claimed to be responsible or sustainable whilst there are no standards that prescribe best practice (e.g., sourcing of broodstock; sourcing of feed; cleaner fish use) to ensure health and welfare.

With 60 million cleaner fish used each year, by the salmon farming sector alone, management and welfare has become an urgent issue requiring swift action.

[98] Scotland Food & Drink (2016). Aquaculture growth to 2030. A strategic plan for farming Scotland's seas. Available from: http://scottishsalmon.co.uk/wp-content/uploads/2016/10/aquaculture-growth-to-2030.pdf [Accessed 23.08.2017]

# 8.0 Recommendations

MCS would like to see the issue of cleaner fish use addressed as a matter of urgency. Specifically:

- Research (e.g., population monitoring, fishing mortality and spatial distribution of fishing efforts) needs to be prioritised to inform management and evaluate its effectiveness.
- Management measures should be appropriate to each species and stock targeted, and enforced in all fisheries throughout the United Kingdom.
    - Fishing seasons should avoid the spawning season of wrasse and Lumpfish species, and reflect the most appropriate time in terms of biology and reproduction.
    - Size limits on cleaner fish species should be set at precautionary levels, to allow the majority (i.e., the length at which more than 50% of the population is sexually mature/Lm50) of male and female fish in a population to have had the opportunity to spawn, and to prevent size related exploitation. (N.B. Size limits should be very carefully considered for species which are protogynous hermaphrodites and are therefore highly vulnerable to size related exploitation (i.e., smaller individuals are female which then become male when they increase in size)).
- As there are no management measures for Lumpfish fisheries, these should be developed as a priority and enforced in all capture areas.
- As the impact of escaped cleaner fish on the genetic diversity of wild populations around the farm is largely unknown, research in this area should be carried out as a priority and used to inform future management measures.
- If farmed fish numbers are inadequate, resulting in the use of wild caught cleaner fish, a precautionary approach should be employed by only deploying fish from well-managed local stocks.
- A transition plan should be developed that phases out wild capture fisheries for cleaner fish in preference for farmed fish. This should have a strong focus on closing the lifecycle of species farmed to ensure hatcheries are no longer reliant on wild populations.
- Criteria which define best practice and responsible production for farmed cleaner fish should be developed and incorporated into all aquaculture standards. These criteria should include health, welfare, escapes and feed sustainability.
- All salmon production standards should incorporate audited criteria for the responsible use of cleaner fish.
- A market should be sought for cleaner fish post-harvest to avoid fish protein wastage.

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