Towards a strategy for humane fishing in the UK

A Mood and P Brooke, November 2019.

We urge the UK authorities and food businesses to develop more humane commercial fishing. Current practices result in poor welfare to very large numbers of fishes. With the growing importance of fish welfare to UK and global consumers, this is a major opportunity to develop welfare-quality branding for UK fishing and to benefit a huge number of sentient animals.

1. Introduction

UK as leader in animal welfare

The UK has long been a leader in animal welfare. For example, the UK was the first country to end veal crates and sow stalls – after which a veal crate ban and a restriction on use of sow stalls were introduced across the EU[1]. In the UK, free range egg production has grown from almost nothing in the 1980's to achieve more than half of total UK egg production (DEFRA, 2019) – despite the fact that free range eggs cost more to buy - and this also demonstrates that the UK consumer is prepared to pay more for higher welfare.

In fish welfare too, the UK is a leader and innovator. A high proportion of British farmed salmon and trout are now reared to RSPCA standards (see section 3), which require humane slaughter. The UK aquaculture industry, with government support, has developed electrical stunning machines (manufactured by the Scottish company "Ace Aquatec Ltd") for the humane slaughter of farmed fish including trout (HSA, 2017; DEFRA, 2001 and 2006). Ace Aquatec Ltd is currently developing a humane stunning system for use on wild caught fish species (Ace Aquatec, personal communication, 2017) and a separate UK company (Crustastun) has previously developed a machine for the humane stunning/killing of decapod crustaceans.

Consumer concern for welfare of fish

British citizens, in common with their counterparts in the rest of Europe and internationally, care about the welfare of animals. A survey conducted for the EU Commission concluded that "*animal welfare is a very important issue for Europeans*" and "*The majority of Europeans are prepared to pay more for products sourced from animal welfare-friendly production systems*" and further that "*Since the last survey, there has been a shift in opinion, with most Europeans now considering there is not a sufficient choice of animal welfare-friendly products available in shops and supermarkets*" (EU Commission, 2016). This poll does not specifically cover fish species but separate market research has shown a willingness of consumers to pay more for

[1] Veal crates were banned in the UK from 1990 and in the EU from 2007; Sow stalls were banned in the UK from 1999 and restricted (banned beyond first month of pregnancy) in the EU from 2013.

better fish welfare in eight European countries studied, including the UK (Feucht and Zander, 2016).

Concern for the welfare of fish is growing internationally. A study of university-educated citizens from Bogota, Colombia, and Curitiba, Brazil into their perception of fish sentience, welfare and slaughter, reported that 80% and 72% of respondents, respectively, perceived fish as sentient beings; and 76% and 72% believed farmed fish should be included in humane slaughter regulation (Rucinque et al, 2017). Note also that most countries in the world are signed up to the codes of the World Organisation for Animal Health (the OIE) which recommend that only humane methods of killing should be used for farmed fish (OIE, 2019).

2. Wild catch fisheries – a major animal welfare issue

Welfare of fish during capture

Considerable suffering is caused to wild-caught fish during capture, landing and subsequent processing (Mood, 2010). Fish are likely to experience fear, pain and distress as they are, for example:

- pursued to exhaustion by nets
- crushed under the weight of other fish in trawl nets
- raised from deep water and suffer decompression effects e.g. burst swim bladders
- snared in gill nets
- spiked with hooks to bring them aboard (if gaffing is used)
- impaled live on hooks as bait (if live bait is used)
- processed, e.g. gutted, while alive and conscious.

In many types of fishing the duration of capture can be very long, lasting hours or even days. Most commercially-caught fish that are alive when landed are not "slaughtered" but are left to asphyxiate or die during further processing which may include gutting, filleting and freezing while alive and conscious. Dutch research found that trawl-caught cod were still alive and conscious when tested after **2 hours** of storage in air (Lambooij et al, 2012). Previous Dutch research found that, even after gutting, fish species take a considerable time (**25-65 minutes**) to lose consciousness (van de Vis and Kestin, 1996).

Number of fishes caught

It is estimated that the average number of wild fish caught globally each year, in the decade to 2016, is between 790 billion - 2,300 billion individuals (Mood and Brooke, 2019a). This estimate is based on FAO reported capture tonnages and average weights for fish species obtained from internet searches. The number of wild fish caught by UK commercial fishing fleets is around 2 billion per year (estimated at between 1.5 and 2.7 billion) as shown in Table 1 in comparison to other animal groups. This number greatly exceeds the 1.1 billion birds and 28 million mammals killed for food in the UK in 2017.

Table 1 Numbers of animals killed in, or caught by, the UK for food annually

Animal group	Numbers of animals (millions)*	Source
Mammals	28	FAOSTAT (data for 2017)
Birds	1,100	FAOSTAT (data for 2017)
Farmed fishes	25-110	Mood and Brooke, 2019b (for 2017)
Wild-caught fishes	1,500-2,700	Mood and Brooke, 2019c; see Appendix 1

* To 2 significant figures

Welfare footprint

The magnitude of an animal welfare problem may be quantified as follows (WSPA, 2003):

Magnitude of welfare problem = *Severity* x *Duration* x *Number of animals affected.*

For commercially-caught wild fish, the severity of suffering is likely to be high, the duration often extended and the numbers very large. This makes the treatment of fish during commercial fishing a major welfare issue.

3. Recent advances in humane slaughter of farmed fish

International welfare codes

The OIE has developed welfare recommendations for the slaughter of farmed fish (OIE, 2019; first adopted in 2010 and last updated in 2012) which state:

"*As a general principle, fish should be stunned before killing, and the stunning method should ensure immediate and irreversible loss of consciousness. If the stunning is not irreversible, fish should be killed before consciousness is recovered.*"

Recommended methods are the following mechanical methods:

- percussive stunning (manual or by specially developed equipment)
- spiking (iki jime)
- shooting (for large fish such as tuna)
- electrical stunning (in water or dry).

Chilling with iced water, asphyxiation by removal from water and exsanguination without stunning are discouraged, as they have been shown to result in poor fish welfare. The UK, like all other EU countries and nearly all other countries globally, has signed up to these codes.

International legal protection

We understand the EU Commission regards OIE Guidelines as the benchmark for assessing compliance with EU law – namely the EU Slaughter Regulation Article 3.1 (EU Council, 2009) which states that "*Animals shall be spared any avoidable pain, distress or suffering during their killing and related operations*" and which also states that its applicability includes fish

species. Unfortunately, in the EU as a whole with the exception of Atlantic salmon, there is widespread non-compliance with the OIE slaughter guidelines, according to a report published by the EU Commission (IBF, 2017).

Norway is the largest producer of farmed fish in Europe[2] and its legislation now requires farmed fish to be stunned prior to slaughter, with percussive and electrical stunning being the two methods used (Norwegian Animal Welfare Alliance, 2016; Norway Seafood Council, 2016). Czech animal protection legislation also specifies requirements for stunning before slaughter of fish (Czech National Council, 1992).

Note also that the UK Animal Welfare Act applies to all vertebrates, including farmed fish.

Humane slaughter of UK farmed fish

In the UK, humane slaughter methods for farmed fish are more widely applied. Atlantic salmon and large trout are typically percussively stunned; small trout are commonly electrically stunned. This has been facilitated over the years by a range of measures:

- Published opinions by the UK government's Farm Animal Welfare Committee e.g. FAWC 1996, 2014
- Defra-funded research and development into humane fish slaughter methods
- A high proportion[3] of UK salmon and trout being produced to RSPCA-Assured certification standards which require humane slaughter (organic standards also require this)
- Supermarkets' own welfare standards requiring humane slaughter.

4. Improving welfare of wild-caught fish

A strategy for more humane commercial fishing will have two main objectives: firstly, to design the fishing method to reduce stress and injury during capture and, secondly, to employ methods of humane slaughter as soon as possible after landing the fish. As was discussed in a paper arising from a workshop on Fish Welfare and Fisheries held by the Fisheries Society of the British Isles (FSBI) in Japan 2008, "*some of the technologies developed for aquaculture, particularly those concerned with humane slaughter, might be applicable in commercial fisheries*" (Huntingford and Kadri, 2009) and this is now beginning to happen.

4.1 More humane methods of capture

A key objective for improving the welfare of wild-caught fish is more "gentle" capture. In practice, gentler capture means designing and adapting the fishing method to achieve

[2] 1.3 million tonnes in 2017 (FAO, 2019).

[3] We believe 70-80% of salmon and over half of trout

minimal levels of injury and mortality, and lower stress levels, in landed fish. A key part of this is that the fishing method should catch and land the fish more quickly.

To achieve clear welfare benefits from gentler capture, the capture and landing must be followed immediately by humane slaughter. There are some examples in the UK and abroad both of fishers using traditional methods of capture that lend themselves to more humane capture, eg fish traps (Mood, 2014) and flyshooting (which can land fish in prime condition because the fish are only in the actual net for a very short time before the net is hauled in (Montgomerie, 2015)), and of fishers using humane slaughter technology. Welfare-friendly approaches are needed for both small and large-scale fishing operations.

A welfare-friendly fishing operation will also need to avoid inhumane treatment of fish used for bait, and to minimise bycatch (including bycatch of non target species and undersized fish) and avoid habitat damage.

Opportunities for more gentle capture

From the point of view of the target species, providing a list of good and bad fishing methods is not straightforward because, firstly all types of fishing method cause stress, injury and potentially mortality; and secondly because the damage caused to wild-caught fish depends on other factors too: the sub type of fishing gear; the fishing context (eg fishing depth) and the size and species of the fish themselves. The ultimate goal is that a fishery can demonstrate that is it achieving low levels of injury and stress (and minimal bycatch) during the capture process.

One review has systematically analysed published research for the effect on fish mortality and injury of different fishing gear types/characteristics (Veldhuizen et al, 2018). The researchers' findings, they say, "*provide options to reduce injuries and mortality from commercial capture fisheries*". According to this review, the design of fishing gear, e.g. shape of hook, affects levels of injury and the following increased the injury and/or mortality of fish during capture:

- longer fishing duration
- higher density in trawl nets (NB longer duration will lead to higher density)
- capture at greater depths due to
    - change in pressure
    - change in temperature
    - may take longer to land
- large change in water temperature during capture (ie if surface water warmer than the depths)
- longer air exposure increased mortality
- trawls and seines have higher mortality than hooks, gillnets and traps
- mortality is higher in smaller fish.

Consideration of the factors influencing levels of damage or stress to fish will help in the development of gentler capture methods. For example, a study of the welfare of wild-caught plaice, one of Europe's commercially most important species, identified some key indicators for better welfare during the capture process for this species (Hürlimann et al, 2014):

- nets of soft material and knotless
- short hauling ie towing duration where plaice is in the net for a short time period
- no/small quantities of bycatch (unwanted materials, debris and other organisms)
- low hauling speed so that plaice is still able to swim within the net and can still move.

Duration of capture
As discussed in section 2, the magnitude of an animal welfare issue may be measured as the product of the severity of suffering, the duration and numbers of animals affected. Hence reducing the duration of the capture process would reduce the distress caused to wild caught fish. A longer duration of fish capture increases the period over which fish suffer and, for several reasons, can also result in a greater severity of distress eg by increasing the crowding and crushing in the net during trawling. Fish may incur injury while trapped in gillnets or on hooks, struggling to escape and unable to evade predators (Mood, 2010).

Landing fish
The process of landing caught fish onboard should be as gentle as possible and be followed immediately by humane slaughter. Time out of water should be absolutely minimised, as should crowding before landing. Handling methods that cause less stress should be used, eg well-designed pumps developed for aquaculture to move fish without injury. If braille nets are used to lift the fish then they should carry water. Where fish are to be handled manually, wet hands should be used or soft wet gloves should be worn (Hürlimann et al, 2014).

For fish species that experience injury with sudden changes in pressure, these should be reduced by bringing the gear to the surface more slowly to ensure a more gradual change in depth and pressure, though the ideal surfacing speed (at which fish are retained in the gear but sustain less pressure injuries) is not known (Veldhuizen et al, 2018).

4.2 Humane slaughter in commercial fishing

Humane slaughter is arguably the most important requirement for improving the welfare of wild caught fish. The welfare benefits of more gentle and quicker capture may not be realised if fish are not subsequently humanely slaughtered but allowed to die during processing or exposure to air. On the other hand, humane slaughter is likely to benefit welfare even where gentler or faster capture has not been achieved, since research has shown that landed fish can remain conscious (and therefore likely to be suffering) for a long time, eg trawl-caught cod where found to be conscious when tested after two hours of onboard storage in dry bins (Lambooij et al, 2012).

In this section we describe the basic methods of humane slaughter as recommended by the OIE for farmed fish; how these methods are beginning to be applied for wild-caught fish and some key opportunities for this. In the killing methods described in this section, we emphasise that these are potentially humane killing methods but need to be implemented properly to achieve the humane objective.

Dry and semi-dry electrical stunning

Electrical stunning systems have been developed for en mass humane slaughter in fish farming and are beginning to be used on fishing vessels. Electrical stunning must be performed correctly or it can be very painful and paralysis may occur without loss of consciousness (IBF, 2017).

In "dry" stunning, an electric current is administered to a fish, after de-watering, on a conveyor belt. Fish may be humanely stunned (ie rendered unconscious within 1 second) by electrical stunning if the necessary electrical parameters are identified for the species (usually in laboratory tests) and achieved in practice. It must also be ensured that fish are subsequently killed before any recovery from the stun. The OIE also refer to "semi-dry" stunning (OIE, 2019). In semi-dry systems, there is a water-filled buffer in front of the stunner and the fish may be sprayed with water between the buffer and the stunner. This reduces the duration of stress caused by being taken out of water.

A collaboration between Dutch and Norwegian scientists has been researching how onboard dry electrical stunning might be achieved using a "STANSAS" stunning machine manufactured by the Norwegian company Optimar (formerly Seaside). Researchers have identified, or partly identified, key parameters for the dry stunning of several wild-caught species including cod and haddock (Lambooij et al, 2012); plaice and dab (Bracke et al, 2013); turbot and sole (Daskalova et al, 2016); mackerel (Anders et al, 2019). The stunner can also be used for large crustaceans such as crabs and lobsters.

A Stansas dry stunner is now in use commercially for the humane slaughter of plaice caught by the Dutch Ekofish vessels "PD147" and, more recently, the "Spes Nova". Marketed as humanely killed, plaice caught by the PD147 went on sale in all Dutch PLUS supermarkets from June 2015 (Visserijnieuw, 2015). The fish stunner dry stuns the fish, before they are killed in iced water, although more research may be still needed to optimize the device (PALSED, 2014; Hürlimann et al, 2014). On the newer vessel, welfare has been improved by keeping the plaice in water prior to the stunning process by landing the netted fish into a tank of water. The Dutch government is currently funding a five-year research project (see Wageningen University, 2019) to test parameters for semi-dry and in-water stunning of demersal (bottom dwelling) fish, and to address some technical issues in using the stunner for wild caught fish (e.g. ensuring fish enter the stunner one at a time and preventing debris entering, a particular problem with demersal fish caught by bottom trawling).

Electrical dry stunning for whitefish has been implemented onboard several national and international fishing vessels, including on some Scottish seiners in Norway, to facilitate easier handling of fish and immediate bleeding after capture (Aursand et al, 2015). Disappointingly, it appears that electric current is applied at a relatively low voltage to immobilise the fish rather than to render them unconscious, as is required by legislation in the Norwegian aquaculture industry (Aursand et al, 2015).

Electrical in-water stunning

With in-water electrical stunning, a current is passed though the water containing the fish. The fish are stunned immediately, and remain unconscious until killed (eg by chilling unconscious fish in ice water), if the voltage and duration of the current are sufficient. These will depend on the species and the conductivity of the water. With in-water stunning the fish do not need to be removed from water (which is highly stressful to fish) for more than a

fraction of a second during the stunning process and so, in principle, in-water stunning may be less stressful to fish than dry stunning (IBF, 2017). Stunning parameters for in-water stunning tested with EEG measurements (ie measurements of brain activity which are the most reliable indicators of consciousness/unconsciousness) are not available.

A Scottish firm, Ace Aquatec, is developing in-water stunners for wild-caught cod, haddock and saithe (personal communication, 2017) which can also be used on crustaceans. Electrical in-water stunning is used to stun (prior to bleeding) longline-caught Alaskan cod as soon as each fish is individually landed on the "Blue North" fishing vessel, as part of the companies "humane harvest" initiative.

Percussive stunning

Percussive stunning is the application of a blow to the head manually or by using a device. It should be performed with sufficient force and accuracy to produce an immediate stun, ie within one second (since a blow to the head is painful when the stun is not achieved immediately), and recovery should not occur (IBF, 2017). To ensure that death ensues without recovery, the percussive stun should be followed immediately by bleeding. Manual percussive stunning is used by some artisanal fishers such as Usan Salmon Fisheries Ltd (Scotland) and Alaskan's Own troll-caught Pacific salmon (Mood, 2014).

Automatic percussive stunning devices have been developed for some species in fish farming and are more reliably accurate than manual stunning. In some cases, the fish are directed to the stunning machines without removing them from water or manual handling (both very stressful to fish) prior to stunning. However, percussive stunning is not suitable for all types of fish. Automatic percussive stunning machines have been used (followed immediately by manual bleeding) for the humane killing of wild Alaskan salmon caught in small purse seines by the company "Wild Salmon Direct" (Wild Salmon Direct, 2006; Mood, 2014). The main challenge for onboard percussive stunning might be the variability of fish sizes caught (see IBF,2017), presumably greater for wild than harvest-size farmed fish.

Spiking (iki jime)

In spiking (also called "ike jime") a fish is killed by inserting a spike into the brain. If this is performed accurately, the fish can become unconscious immediately. This is a traditional method used in some longline and trolling fisheries where fish have their brains spiked as soon as they are landed, which delays onset of rigor and benefits quality (Gregory, 1998). Spiking has not yet been automated for fish farming due to the difficulty in accurately locating the brain with varying fish size.

A hand held device called the "Ikigun" has recently been developed in New Zealand to enable anglers to easily employ the spiking method (Fishing World, 2013). It is marketed as a "*simple, humane way to kill fish that improves taste*" and suggests another option for artisanal fishers who handle fish individually, though it is not marketed for high volume commercial fishing (see www.ikigun.com). The Australian government has developed codes that recommend spiking as a method of humane killing in its commercial rod and handline fisheries (AAWS, 2012) and has produced a video explaining how to do it (see www.ikijime.com).

Key welfare opportunities for wild caught fish

The key areas of opportunity for improving the welfare of commercially-caught fish are:

1. to adapt automated humane stunning/killing systems used in aquaculture for use onboard fishing vessels
2. to ensure that stunning machines on fishing vessels are aiming at, and achieving, humane stunning (immediate anaesthesia lasting until death)
3. to widen the use of traditional manual methods of humane stunning/killing in artisanal fisheries (namely percussive stunning and spiking)
4. the development of semi-automatic devices to improve on the methods in 3.

Examples of 1,3 and 4 above are shown in Table 2.

Table 2 Application of potentially humane stunning/killing in wild catch fisheries worldwide

Stunning/killing method	Manual	Semi-automatic (hand-held or hand-fed device)	Automated system
Percussive stunning	Some artisanal fisheries e.g. Usan fisheries (Mood, 2014; fair-fish, 2007)		Wild Salmon Direct (experimental)
Spiking (iki jime)	E.g. Japanese market and some long line fisheries (for quality)	Ikigun used in recreational fishing	
Electrical Stunning (in water)			Blue North. Ace Aquatec stunners (potentially)
Electrical Stunning (dry)			Ekofish (Optimar stunner, previously known as "Stansas" or "Seaside"). Optimar stunners are installed on fishing-vessels in Norway, Iceland, Holland, the US and Canada (personal correspondence, 2017).
Electrical stunning of crustaceans (in water)			Ace Aquatec stunners (potentially)
Electrical stunning of large crustaceans eg crabs and lobsters (dry)		Crustastun (single stunner for restaurants)	Crustastun (reportedly used for Tesco and Waitrose). Hitramat AS (Optimar stunner for edible crabs (Roth and Grimsbø, 2013)

4.3 Welfare quality assurance

The killing methods described in this document need to be implemented properly to achieve the humane objective. Van de Vis et al (2016) propose the three main steps to establish effective humane stunning and killing of farmed and captured fish. In the context of electrical or percussive stunning, the basic steps are:

1. In a laboratory setting, determine the conditions required for an effective stun without avoidable stress, pain and fear. EEG and ECG measurements of fish are needed in addition to behavioural observations because fish not displaying signs of consciousness can still be conscious, as evidenced by measurements of brain activity.

2. Test the stunning or stunning/killing method in a (semi-) commercial setting. This includes physical measurements of the stunning equipment (such as strength of current for electrical stunning and air pressure for percussive stunning) and behavioural observations of the fish. The researchers stress that caution is needed in the interpretation of behavioural observations of fish since fish may still be conscious but unresponsive due to, for example, paralysis or exhaustion.

3. Once industry has installed equipment and adopted humane stunning, ongoing control (measurements and corrective action where needed) to ensure effective stunning. To achieve this, a process-oriented Quality Assurance system could be used as described by (Van de Vis et al (2012).

5. Value-added benefits from ethical "care of the catch"

The term "care of the catch" is sometimes used to mean better handling to achieve product quality and value. Consumers will increasingly expect ethical care of the catch to mean more humane treatment as well as product quality. Ethical care of the catch can bring several benefits.

Welfare quality and premium

With growing pressure on wild fish stocks, it makes perfect sense to increase the value of each animal caught. Improving animal welfare provides an opportunity to add value and to provide a superior product that can attract a welfare premium.

Food quality

Humane killing of fish can bring improved food quality by reducing pre-slaughter muscle activity, which is one of the reasons that *iki jime* is traditionally used. SINTEF research scientist, Dr Hanne Digre, found that reducing the stress experienced by caught fish improves the eating quality (SINTEF, 2016). According to the US company Blue North's website, the humane slaughter of wild-caught cod on its pioneering vessel (see section 4.3) improves nutritional and eating quality as well as shelf life.

Worker health and safety

Researchers at SINTEF, Norway, have been developing electrical stunning of trawl-caught cod and haddock. SINTEF researcher, Dr Digre, argues that electrical stunning can benefit fishers

as well as fish welfare. Currently, it is common to gut fish manually, which is a cumbersome and hazardous job for the fishermen, and is made safer, easier and more efficient by stunning the fish first (SINTEF, 2016).

Sustainability

Adding welfare and quality value to each fish can help to maintain incomes as part of sustainable fisheries management. Blue North's care of the catch enables it to efficiently utilise proteins that currently go to waste (Blue North, 2017b).

6. Conclusion

The UK should act quickly to develop systems for humane killing onboard its fishing vessels and more gentle methods of capture and landing of fish. The opportunity to improve welfare is substantial. We understand that food businesses are interested in being able to provide humanely caught fish to their customers. We expect that increasing numbers of fishers will choose to improve the way they handle their catch, given the right knowledge and technology. Animal welfare can help fishers add value to each fish and make it a superior product.

Development of humane fishing would benefit greatly from industry-wide initiatives and the support of government. The UK Government has helped to solve similar problems in UK aquaculture, working together with UK industry and scientists, and has a key role in the development of more humane fisheries.

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Appendix 1 – Estimated average annual numbers of fishes caught by UK Fishing Fleets in 2007-2016 (Mood and Brooke, 2019c)

Fish species (Scientific name)	Average annual capture by UK fleets 2007-2016[1]	Percent of total %	Estimated mean weight range (g) (various sources[2])	Estimated number range (lower) in millions	Estimated number range (upper) in millions
Atlantic mackerel (Scomber scombrus)	185,826	38	389-454	409	478
Atlantic herring (Clupea harengus)	82,143	17	100-600	137	821
Haddock (Melanogrammus aeglefinus)	34,466	7	900-1,800	19	38
Atlantic cod (Gadus morhua)	25,843	5	800-4,000	6	32
Blue whiting(=Poutassou) (Micromesistius poutassou)	23,085	5	135-340	68	171
European plaice (Pleuronectes platessa)	17,378	4	1,100	16	16
Angler(=Monk) (Lophius piscatorius)	15,728	3	30,000	1	1
Saithe(=Pollock) (Pollachius virens)	14,254	3	2,200-4,500	3	6
Atlantic horse mackerel (Trachurus trachurus)	13,129	3	159.83	82	82
Whiting (Merlangius merlangus)	11,185	2	121.88-164.87	68	92
European hake (Merluccius merluccius)	8,913	2	1,800	5	5
European pilchard(=Sardine) (Sardina pilchardus)	8,124	2	68.8-127.17	64	118
European sprat (Sprattus sprattus)	5,203	1	16.64	313	313
Round sardinella (Sardinella aurita)	4,583	1	100	46	46
Sandeels(=Sandlances) nei (Ammodytes spp)	2,618	1	10	262	262
Lemon sole (Microstomus kitt)	2,454	< 1	649-885	3	4
Common sole (Solea solea)	2,259	< 1	23.32-970.85	2	97
Patagonian toothfish (Dissostichus eleginoides)	1,253	< 1	9,000-10,000	< 1	< 1
Witch flounder (Glyptocephalus cynoglossus)	1,144	< 1	300-1,000	1	4
Rainbow trout (Oncorhynchus mykiss)	949	< 1	500-5,000	< 1	2
Others with estimated mean weight (80 species)	12,705	3	various	21	95
Total of above	**473,241**	**96**		**1,526**	**2,683**
Others (83 species)	21,322	4		Not estimated[3]	Not estimated[3]
Total	**494,563**	**100**			

1. Source of production tonnage: FAO FishStat "Capture Production 1950-2016 (Release Date: 15th March 2018)".

2. Source of estimated mean weights (EMWs): as described in Mood and Brooke, 2010.

3. The fish numbers for species without an estimated mean weight (EMW) have not been estimated.