



Severn Salmon and Sea Trout stock assessment and review of fisheries regulations

Technical case for Net Limitation Order and fishery byelaws

February 2021

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Executive summary

This document reviews the status of salmon and sea trout stocks in the River Severn, and recommends the imposition of appropriate rod and net fishery regulations which reflect the current risk status, and are required to protect the productive capacity of these stocks. These regulations are also required in order to minimise the impact of the Severn estuary net fisheries on the exploited stocks of the nearby rivers Wye and Usk, Special Areas of Conservation (SACs).

The Severn salmon stock had been on an improving trend up to and including 2017, being classified as “Probably Not at Risk” at that time. However, marked declines in 2018 and 2019 mean the stock is currently declining and is now categorised as being “Probably at Risk” of failing to meet its Management Objective (MO). The stock is predicted to remain “Probably at Risk” in five years’ time. The salmon stock assessments in 2018 and 2019 only achieved 66% and 51% of the Severn Conservation Limit (CL) level respectively, representing a substantial deficit in the number of spawning adult salmon in these two years.

The average population densities of juvenile salmon recorded from fisheries surveys conducted in the upper Severn catchment were at their lowest recorded levels in the 2019 survey. This is likely to reflect reduced numbers of spawning adult salmon in the preceding two years, and also suggests that smolt production might be reduced in 2020 and 2021 with consequent reduced adult salmon returns in 2022 and 2023.

It is important to stress that the Environment Agency recognises this recent decline in the Severn salmon stock (and in other river catchments) is not solely due to either rod or net fishery exploitation. We accept there is a clear need to highlight and address a range of other environmental factors, both within freshwater and the marine environment, that are impacting salmon stocks and that reductions in fishery exploitation alone will not be sufficient to recover stocks. Our own Decision Structure guidance directs us to implement fishery regulations to improve the status of the stock to achieve a classification of Probably Not at Risk within five years. We acknowledge that preparing an action plan to address other impacts is recommended alongside the imposition of fishery regulations.

The net and fixed engine salmon fisheries (lave, draft and putcher ranks) in the Severn estuary that are regulated by the Environment Agency, are known to exploit salmon destined to return to the rivers Wye and Usk which also drain into the Severn estuary. The Severn estuary salmon net fisheries can therefore be considered to be a localised mixed stock salmon fishery.

Both the River Wye and Usk are designated as Special Areas of Conservation (SACs) with Atlantic salmon as a specific designated feature. Consequently, the status of salmon stocks in these rivers must also be duly considered in the regulation of these estuary net fisheries. The Wye and Usk salmon stocks have also experienced concerning declines within the last two years and are both classified as being “Probably At Risk” of failing the MO now and are also expected to remain in this category in five years-time. Particularly poor juvenile salmon recruitment, as determined from recent fisheries monitoring surveys, has also been evident, thereby giving cause for concern for the potential future status of returning adult salmon stocks on both of these rivers. Natural Resources Wales (NRW) implemented a comprehensive suite of salmon and sea trout protection byelaws in 2020, including rod fishery measures, in response to the widespread decline in salmon and sea trout stocks in Welsh rivers, with corresponding regulations also implemented by the Environment Agency on the English parts of the cross-border rivers Wye and Dee.

The exploitation of salmon by the Severn estuary net fisheries has been controlled in recent years through a catch limit allocation. This was implemented in order to protect stock sustainability and took into account the need to reduce the impact of net fishery exploitation of the Wye and Usk SAC designated salmon stocks. However, in light of the recent deterioration in stock status on all of the three major rivers (Wye, Usk and Severn) which contribute adult salmon to the River Severn estuary net fisheries, the catch limit allocation method no longer offers sufficient protection for fish stocks and any continued harvesting of salmon by the estuary net fisheries is likely to be detrimental to stock recovery.

Similarly, the continued killing of salmon by the Severn rod fishery is also likely to be detrimental to the recovery of that stock.

The Environment Agency has considered a range of fishery management options to facilitate salmon stock recovery on all contributing rivers and to safeguard the sustainability of future salmon rod and net fisheries.

The preferred option for the Severn estuary net fisheries, in order to minimise their impact upon the River Severn salmon and sea trout stocks, as well as the salmon stocks in the nearby Wye and Usk SAC rivers, is as follows:

- Implementation of byelaws prohibiting the use of the estuary draft net and putcher fisheries to capture salmon and sea trout for the next ten years.
- Implementation of a byelaw requiring the mandatory catch and release of all salmon and sea trout caught by the lave net fishery for the next ten years.
- Implementation of a Net Limitation Order to restrict the number of available lave net fishing licences to 22.

These proposed measures will enable the Environment Agency to meet its obligations under the Habitats Regulations to protect the Wye and Usk SACs. They are also consistent with regulations already introduced on other principal salmon rivers in England, which also seek to protect salmon stocks designated under the Habitats Regulations. Furthermore these measures complement those introduced by NRW in January 2020, to reduce the fishing mortality of salmon and sea trout in Welsh net fisheries.

The preferred fishery management option for the River Severn rod fisheries, is as follows:

- Implementation of a byelaw that requires the mandatory catch and release of all salmon and sea trout caught by rod and line.
- Implementation of byelaws that control fishing methods, namely:
 1. prohibit bait fishing for salmon and sea trout;
 2. require the use of barbless hooks for fly fishing for salmon and sea trout;
 3. require the use of single, barbless (barbless or de-barbed) hooks with a maximum hook gape of no more than 13mm to be used with any artificial lures and spinners used to target salmon and sea trout;
 4. no more than 3 single, barbless hooks with a maximum hook gape of 13mm are to be fitted to wobbling or jointed plugs used to target salmon or sea trout;
 5. barbless single, double or treble hooks may be used in conjunction with a fly for salmon and sea trout. However, the maximum hook gape of any double or treble hook used in conjunction with an artificial fly shall be no greater than 7mm, and 13mm for single hooks.

The sea trout stock of the Severn appears to be relatively small, with no historic records of substantially higher abundance, and no targeted fisheries for this species. Notwithstanding this apparent low stock level, we would not wish to see any increased exploitation of sea trout by the Severn net or rod fisheries in the future. For this reason, and also to avoid any possible mistaken identification between species, sea trout have been included in the proposed regulations.

The overall package of proposed measures has been designed to enable rod fishing to continue in a more sustainable way to maximise the opportunity for salmon stock recovery and to protect the sea trout stock. The proposed measures recognise and take into account the fact that certain types of angling methods and use of gear types can result in increased fish mortality following catch and release thereby reducing spawning escapement. In combination, and based on recent catch levels, these regulations would be expected to save in the region of 100 to 200 salmon per year.

The overall suite of salmon protection measures is intended to be reasonable and appropriate to the differences between all fisheries concerned. We believe they are proportionate to the level of risk and adversely impacted status of the salmon stocks. It is proposed that these measures need to be in place for a maximum of ten years with a mid-term review proposed after five years. There is also a recognition that the decline in salmon observed on all contributing rivers in both England and Wales is not only directly attributable to either rod or net exploitation of these stocks. Other factors limiting salmon productivity in freshwater also need to be reviewed and addressed with a clear, prioritised plan of action implemented at the earliest opportunity in order to maximise the benefits from reduced rod and net fishery exploitation. The Environment Agency therefore also intends to work collaboratively with partner organisations and interested stakeholders to fulfil this requirement.

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1 Introduction

This document describes the recent status of salmon and sea trout stocks on the River Severn and the performance of the Severn rod and estuary net fisheries. The data has been used to inform and develop a suite of appropriate regulations which are necessary to allow salmon stock recovery and sustainability.

1.1 Environment Agency's fisheries duties and responsibilities

The Environment Agency has a statutory duty, defined in the Environment Act 1995, to "maintain, improve and develop fisheries". In addition, we have a statutory duty to operate a licensing system for fishing under the Salmon and Freshwater Fisheries Act 1975. The powers to meet these duties are contained primarily in the Salmon and Freshwater Fisheries Act 1975 (including licensing of angling and net fishing), the Water Resources Act 1991 (including the powers to make byelaws to regulate fishing), the Eels (England and Wales) Regulations 2009 (including powers to facilitate eel passage) and the Keeping and Introduction of Fish Regulations 2015 (including regulating the movement and introduction of fish).

Council Directive 92/43/EEC, commonly referred to as the Habitats Directive (on the conservation of natural habitats and of wild flora and fauna) states that: "*If a species is included under this directive, it requires measures to be taken by individual member states to maintain or restore them to favourable conservation status in their natural range*"¹.

The Atlantic salmon (*Salmo salar* L.) is a species listed in Annex 2 of the Habitats Directive. Within England, there are currently 12 rivers (or tributaries of rivers) designated as Special Areas of Conservation (SAC) where salmon are a named qualifying interest. This places an additional requirement on regulatory bodies such as the Environment Agency and the UK Government to maintain the habitats and population status of salmon in these rivers in a favourable condition. Any proposed amendment to salmon fishery regulations for net or rod fisheries that have potential to impact upon salmon populations within these rivers, will require consideration of these statutory designations.

Salmon stocks in England are managed in line with the guiding principles set out by the North Atlantic Salmon Conservation Organisation² (NASCO). Further information on the NASCO guidelines relating to salmon fisheries management are available at:

<https://nasco.int/wp-content/uploads/2020/02/Fisheries-Guidelines-Brochure.pdf>

In brief, these guidelines indicate that conserving the productive capacity of individual river salmon stocks should be given priority. The guidelines further state that harvesting of

¹ The Habitats Directive is given effect by the Conservation of Habitats and Species Regulations 2017 (the 2017 Regulations). In preparation for EU Exit the Secretary of State for the Environment, Food and Rural Affairs and Welsh Ministers have made changes to parts of the 2017 Regulations so that they operate effectively. Most of these changes involved transferring functions from the European Commission to the appropriate authorities in England and Wales. All other processes or terms in the 2017 Regulations remain unchanged and existing guidance is still relevant. The obligations of a competent authority in the 2017 Regulations for the protection of sites or species do not change.

² NASCO is an international organisation established by an inter-governmental Convention in 1984. Their objective is to conserve, restore, enhance and rationally manage Atlantic salmon through international cooperation taking account of the best available scientific information.

salmon should not be permitted on stocks which are below their Conservation Limits³. If a decision is made to allow fishing on a stock which is below its Conservation Limit (CL), on the basis of overriding socio-economic factors, fishing should clearly be limited to a level that will still permit stock recovery within a stated timeframe.

The numbers of adult salmon returning to spawn in a river each year, and hence the number of eggs deposited, are estimated and compared against the CL. The CL is considered to be the **minimum safe level of spawning salmon** (described as the number of salmon eggs deposited) for each river. **By regularly failing to reach this limit, the risk of that river's salmon stock suffering serious decline greatly increases.**

Because salmon stocks naturally vary from year to year, the Environment Agency aims to ensure that a stock meets its CL in at least four out of five years on average (i.e. >80% of the time); this is the Management Objective (MO). To meet this MO, the average level of a stock typically needs to be approximately 40% above the CL. This higher target level is referred to as the Management Target (MT)⁴.

The status of salmon stocks in the 42 principal salmon rivers in England is assessed annually against the river specific CL, MT and MO. The annual results from these assessments are used as a basis for determining the need for fishery management measures to ensure that stocks remain at sustainable levels to support their dependent fisheries. This method is further described in Annex 7 of the *Assessment of Salmon Stocks and Fisheries in England and Wales* (Cefas, Environment Agency and NRW, 2019) and is appended to this document (Appendix 1).

It is also important to consider the trend for a particular stock and whether it is stable, improving or deteriorating. Stocks are therefore classified according to whether, on the basis of the trend over the past 10 years, they are likely to meet the MO in five years' time. This system gives an early warning of where a river's salmon stock will be, if current trends are maintained. Stocks are allocated to one of four categories based on this annual compliance assessment and the likelihood of meeting the MO (Table 1).

Table 1 Probability of meeting the Management Objective and the associated risk category

Probability of meeting the Management Objective	Equal or greater than 95%	Greater than 50% and less than 95%	Greater than 5% and less than 50%	Equal or less than 5%
Category name	Not At Risk (NAR)	Probably Not at Risk (PNaR)	Probably at Risk (PaR)	At Risk (AR)

To assist in determining the appropriate level of exploitation for a river's salmon stock, a national salmon fishery management Decision Structure (Appendix 1) has been used since 2007. The Decision Structure helps to guide a consistent approach to the implementation of management measures. It seeks to manage exploitation at a sustainable level that promotes stock recovery, whilst minimising the social and economic impacts of the measures to control exploitation. This approach has informed local controls

³ The Conservation Limit (CL) is the minimum spawning stock level below which stocks should not be allowed to fall. The CL for each river is set at a stock size (defined in terms of eggs deposited) below which further reductions in spawner numbers are likely to result in significant reductions in the number of juvenile fish produced in the next generation.

⁴ The Management target (MT) is a spawning stock level for managers to aim at in order to meet the Management Objective (MO) that the stock should, on average, be meeting or exceeding its CL in at least four years out of five (i.e. >80% of the time).

which seek to maintain an equitable balance between rod and net exploitation. Examples may include reductions in the number of annual net licences available; changes in the netting season to reduce the salmon catch; or the introduction of 100% catch and release (C&R) for the rod fishery, all designed to maximise the numbers of salmon available to spawn.

The decline in salmon stocks across the North Atlantic (and also the North Pacific) has prompted both national and international initiatives by relevant partners to better understand and manage those stocks.

In England, the Salmon Five Point Approach is a multi-agency initiative to restore the abundance, diversity and resilience of salmon stocks throughout England by:

- a) Maximising the production of healthy wild salmon smolts in freshwater and seeking to reduce salmon mortality at sea.
- b) Working in partnership across Government, its agencies and partner organisations to introduce new initiatives and improve the delivery of existing measures to protect and maximise salmon stock performance.

The five workstreams of this approach are:

1. Improve marine survival
2. Further reduce exploitation by nets and rods
3. Remove barriers to migration and enhance habitat
4. Safeguard sufficient flows
5. Maximise spawning success by improving water quality

This review of fisheries regulations for the Severn forms part of the second workstream of further reducing exploitation by nets and rods.

1.2 Description of the River Severn Catchment

The River Severn rises on the slopes of Plynlimon in the Cambrian Mountain range of Mid Wales. At around 220 miles from source to sea, it is the longest river in the UK and has the largest water flow of any river in England and Wales. From its source, the Severn initially flows in a north easterly direction, through the towns of Llanidloes and Welshpool. Crossing the border into England, it takes a more southerly course and loses its upland character whilst flowing through Shropshire, Worcestershire and Gloucestershire before entering the Severn estuary below Gloucester.

Large areas of the middle and upper Severn catchment, particularly the upper reaches and the Vyrnwy and Teme sub-catchments, comprise high quality juvenile salmonid rearing habitats. Monitoring shows that most of the main stem rivers and tributaries support juvenile salmon populations, which are regarded as the primary salmon spawning areas.

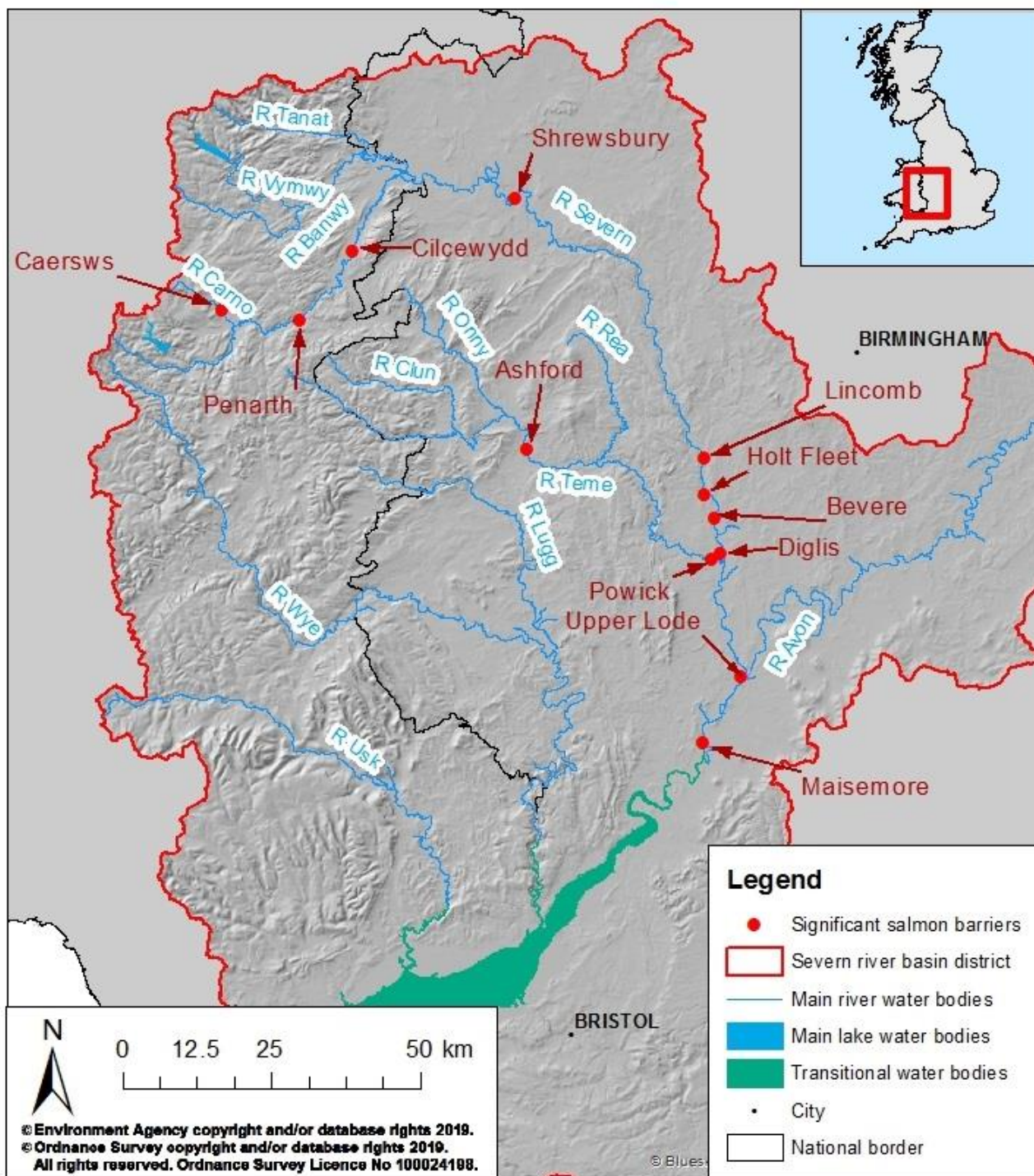


Figure 1 River Severn catchment including significant rod fishing locations principally associated with the navigation weirs.

1.3 Description of the River Severn fisheries

For English and Welsh cross border rivers, such as the River Dee, River Wye and River Severn, the Environment Agency is the regulatory authority for all rivers that are in England and NRW is the lead authority for all those rivers that are within Wales. There is a formal agreement that NRW will take the lead for migratory salmonid fisheries management on the Rivers Dee and Wye, with the Environment Agency taking the lead role for the River Severn.

Fisheries regulations that apply to any of the cross border rivers must be implemented by each respective jurisdiction to ensure a consistent regulatory regime throughout the catchment. Therefore, NRW and the Environment Agency work collaboratively to ensure that any measures that are implemented in England or Wales are consistently applied across the respective catchments.

The River Severn is best known for its coarse fishing particularly for barbel and chub in the middle reaches. It supports a relatively small salmon rod fishery, comparative to its size and length, and is widely regarded for its early run of large, multi-sea winter salmon. Rod and line fisheries for salmon operate throughout the freshwater extent of the Severn, including on some key tributaries. Salmon angling is focussed around 12 main weirs around the catchment (**Figure 1**), although byelaws prevent fishing within defined distances upstream and downstream of the main weirs. For example, salmon angling is prohibited within 15m upstream and 45m downstream of Shrewsbury weir. Upper Lode Weir at Tewkesbury, Diglis Weir at Worcester and Shrewsbury Weir are amongst the most popular, and therefore most productive, salmon angling locations, often accounting for almost half the total Severn rod catch in some years.

Salmon fishing on the Severn has always been generally regarded by anglers as accessible and affordable, with much of the salmon fishing rights retained in public ownerships, e.g. local authorities and the Canal and Rivers Trust, being operated and managed by clubs and associations, rather than private riparian owners. The salmon fishery attracts approximately 300 anglers per year but the vast majority of the declared catch is taken by a few fishermen, who know the river well and are expert in the use of the angling methods employed to catch salmon. The fishery has often been referred to as an “everyman’s salmon fishery” or previously a ‘table fishery’ when almost all fish were taken to support local families.

Fishing rights are largely controlled by fishing clubs and angling syndicates. Long standing local byelaws set out the salmon fishing seasons, angling methods and period when mandatory C&R of salmon applies.

Spinning or lure fishing is the most popular method of salmon angling on the River Severn, especially the use of Devon minnows and Flying ‘C’ type lures. Bait fishing with worms remains a popular method, outside of the spring salmon byelaw restricted period. This applies from the start of the season, 1 February and runs to 16 June each year. This method accounts for about a third of the average annual catch. Fly fishing is the least favoured method, usually accounting for less than 10% of all fish caught and practiced mainly in the Mid to Upper river where the river channel is more natural.

The Severn estuary is a large transitional water with an extensive range of habitat types and a very large tidal range. Salmon fishing has been practiced in the estuary for at least 2000 years and this has resulted in the development of specific techniques for the capture of salmon, including subtle adaptations of more familiar netting and trapping techniques. Within the last 30 years, three main methods have been used to catch salmon in the Severn estuary, namely - historical installations or putcher ranks, also referred to as fixed engine fisheries; lave nets; and draft or seine nets (further details in Appendix 2). The defined area of the estuary where these fisheries operate is illustrated in **Figure 2** below.

In the mid-nineteenth Century, the Severn salmon fishery was the largest commercial salmon fishery in England and produced substantial commercial catches up until the 1990’s. With the decline in salmon stocks in the last 30 years, the scale of fishery has diminished considerably and is no longer supporting a substantial commercial fishery.

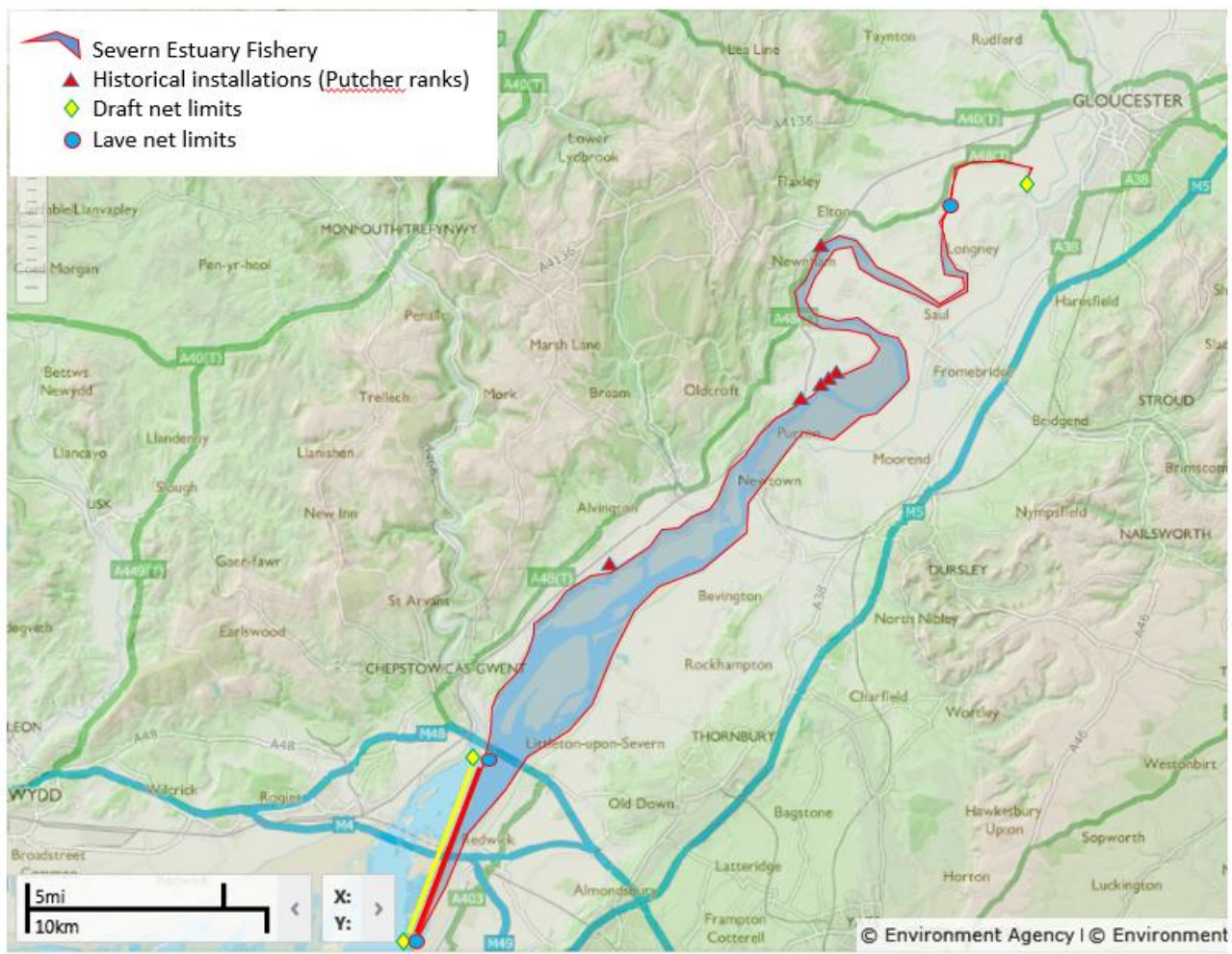


Figure 2 Map to show limits of Severn estuary net (Draft, Lave) fisheries and the locations of the fixed engine fisheries (Patcher ranks)

The Severn estuary fisheries have been shown to exploit a mixed stock of salmon that are destined not just for the river Severn, but also for the nearby rivers Wye and Usk. The status of salmon stocks in these two rivers is therefore duly referenced within this document in relation to the regulation of these estuarine fisheries.

Salmon Conservation designations

A number of key protected sites are situated within or close to the area where the estuary salmon net fisheries operate. Specifically, these are:

- **River Wye SAC (Special Area of Conservation)**
- **River Usk SAC**
- **Severn Estuary European Marine Site (EMS), comprising the Severn Estuary SPA (Special Protection Area), the Severn Estuary SAC and the Severn Estuary Ramsar site.**

Salmon are a specific qualifying interest feature of the Wye and Usk SACs, and of the European Marine Site, and are classified as being in unfavourable or unclassified condition in all three protected sites. The Conservation of Species and Habitats Regulations 2017 (as amended) transposed the EC Habitats Directive 1994 into UK law. The UK Government and devolved administrations therefore have a statutory

responsibility to maintain and restore designated sites and qualifying species to a favourable conservation status wherever possible.

In considering applications for net and putcher licences, that will potentially exploit salmon destined for a designated river catchment SAC (River Usk or Wye), the Environment Agency must consider Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended). This requires the Environment Agency to determine whether the scale and operation of the net fisheries alone and in combination are likely to have a significant effect upon the designated SAC features. Where there is likely significant effect the Environment Agency must undertake an appropriate assessment to ascertain whether it can conclude no adverse effect on integrity of the SAC from the net fisheries. When undertaking the appropriate assessment for the Severn estuary net fishery, the Environment Agency is required to consult and take advice from the statutory nature conservation bodies within England and Wales which are Natural England (NE) and NRW respectively. The record of the most recent HRA assessing the impacts of the estuarine net fishery on the Wye and Usk SACs, Severn Estuary European Marine Sites (EMS) and Sites of Special Scientific Interest (SSSI) features appears in Appendix 3.

Recent fisheries regulations

In the last 30 years, the Environment Agency and NRW have introduced a variety of increasingly restrictive fishing regulations for both net and rod fisheries on the rivers Severn, Wye and Usk, in response to declining salmon stocks. Since 1995, 18 separate salmon protection measures have been implemented across these fisheries which include byelaws, net limitation orders, catch allocation licence conditions and elected closures. In 2019 and 2020 emergency byelaws were made and extended respectively.

Mandatory catch-and-release (C&R) and other rod fishing controls have been applied to the Wye rod fishery since 2012, which have sought to limit salmon mortality from rod and line angling. This is in addition to the promotion of best practice C&R guidelines to maximise the post release survival of salmon.

Since 2012, the Environment Agency has applied catch limits to the Severn estuary net fisheries in order to minimise their impact on salmon stocks, especially on the Wye SAC stock which was considered to be the weakest of the three stocks contributing to the estuary net fishery. The catch limits were defined as a Total Allowable Catch (TAC), and sought to balance the estimated level of salmon mortality likely to be present within the River Wye rod fishery, approximately 20% of all rod caught fish, with the exploitation of salmon in the estuary net fishery. The TAC was applied across the fisheries based on historic catch records with 80% allocated to the putcher/fixed engine fishery, 18% to the lave net fishery and 2% to the draft net fishery. For putcher fisheries, the number of salmon that each anticipated licence-holder was permitted to catch was calculated proportionately, based upon the number of putcher baskets deployed. This resulted in differing TAC for each putcher/fixed-engine licence-holder. Allocated catches were rounded down to the nearest whole number of salmon. The application of the TAC method (see Table 2, page 31) allowing a continued limited harvest of salmon was acceptable until 2018 when the Wye salmon stock stopped improving and demonstrated a decline.

Conclusion of 2019 Severn Estuary Fishery Habitats Regulations Assessment

The appropriate assessment required by Regulation 63 of the Habitats Regulations for the 2019 netting season could not conclude with certainty, that there would be no adverse effect by the setting of TAC conditions (Appendix 3). The result was, as there was no harvestable surplus of salmon available, no allowable catch allocation could be set. However, the circumstances were such that an emergency byelaw was made, informed in part by the conclusions of the appropriate assessment.

Although the overall net catch has markedly declined through a combination of reduced participation and the implementation of measures to reduce catch, this saving has not transferred through to any marked improvement in the CL status for all three rivers. It may however, have reduced the impact of the serious decline in adult salmon stocks that has been observed since 2018 (see Cefas, Environment Agency and NRW, 2020).

2 Salmon Stock Assessment

In reviewing the River Severn salmon stock assessment calculations, several over-estimates of important parameters were identified and have been revised accordingly. These are:

- Fish weight – The standard method of stock assessment bases the egg deposition calculations on the range of actual weights of salmon recorded from declared rod catch returns, and the declared numbers of fish within each one pound weight category for the respective river and year. Prior to 2018, the annual Severn salmon stock assessment calculations did not incorporate fish weight data in this way but instead used a simplistic fixed weight for one sea-winter (1SW) salmon of 2.9kg, and 7.3kg for multi sea-winter (MSW) salmon. The source of these average weight data is not known but may have been derived from historic samples of salmon from the estuary net and fixed engine fisheries. We have therefore reverted to using the Severn-specific yearly weight distribution data, including for previous years, as a more realistic description of Severn salmon weights.
- Fecundity (eggs per kg) – Prior to 2018, the annual Severn salmon stock assessments used a value of 1,769 eggs per kg of female body weight in calculating the total egg deposition. The source of this value is unknown but may have been derived from historic samples of salmon from the estuary net and fixed engine fisheries. However, the value derived from the Pope equation (Pope *et al.*, 1961) for typical sizes of salmon from the Severn, and also observed in Severn salmon at the Clywedog hatchery in the 1990's and 2000's (C Bainger, personal observation), is around 1200 to 1300 eggs per kg. We have therefore reverted to using the Pope equation, as is used for other rivers, in calculating the annual Severn salmon egg production.

(Pope, J.A., Mills, D.H. and Shearer, W.M. (1961). The fecundity of Atlantic salmon (*Salmo salar* Linn). Freshwater and Salmon Fisheries Research 26, 1-12.)

As a consequence of applying these weight and fecundity changes, the annual egg deposition calculations have reduced. The updated Severn stock assessment for 2010 to 2019 is presented in **Figure 3** below.

An estimated exploitation rate of 11% has been applied to all annual Severn stock assessments since the publication of the Severn Salmon Action Plan in 2001. Given the manner in which rod fishing is generally concentrated immediately downstream of weirs on the Severn, where salmon congregate, it is possible that higher exploitation rates might be more valid for this river. However, for the stock assessments used here, and until such time as better evidence might direct us to change this, we will continue to base these annual assessments on an 11% exploitation rate.

The Severn salmon stock has regularly failed to achieve its CL and is now classified as being 'Probably at Risk' of failing the MO in the 2019 stock assessment, and is predicted to remain so in five years' time.

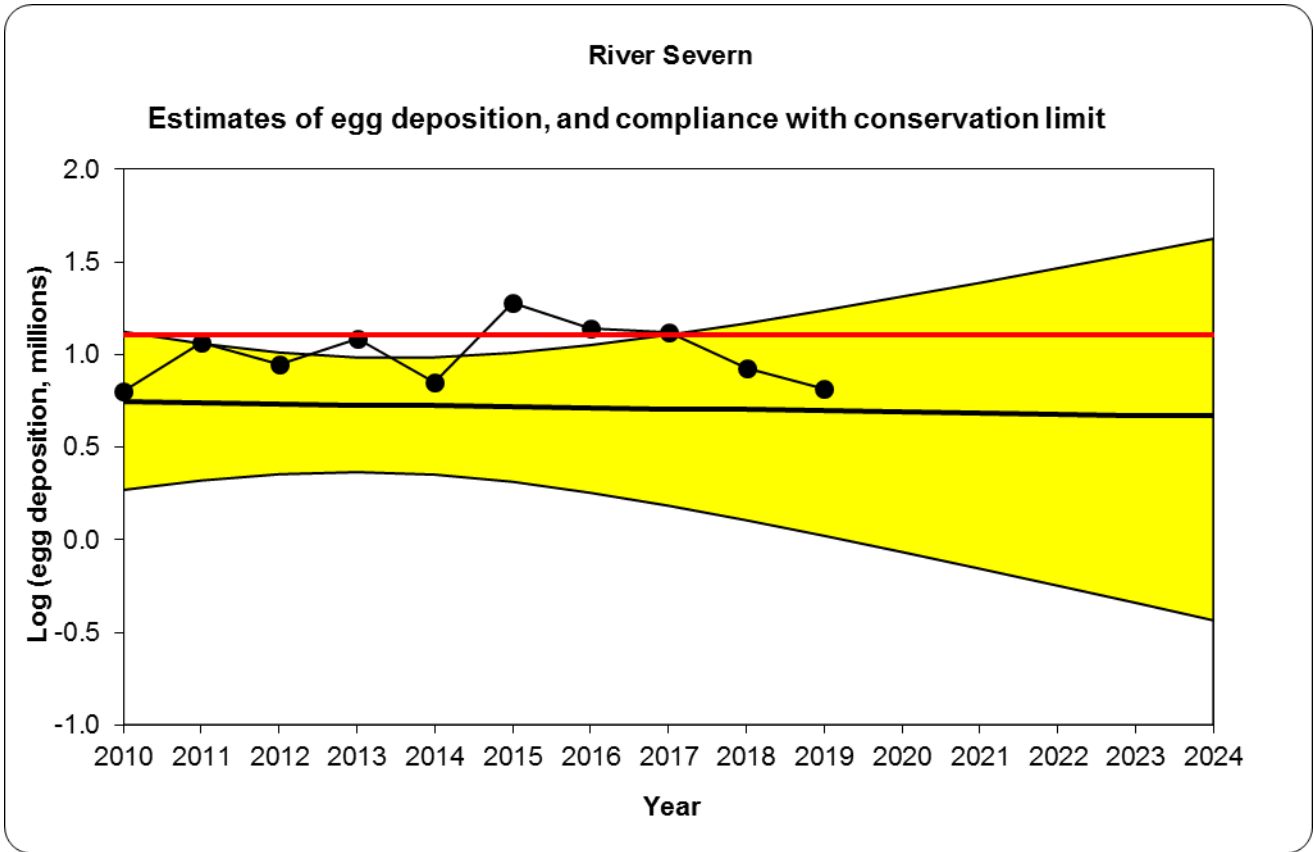






Figure 3 River Severn compliance against the CL from the 2019 assessment based on updated fish size and fecundity estimates

Key to graphs	
	20 th percentile trend line for egg deposition estimates
	Annual egg deposition estimates
	Conservation Limit
	Upper and lower boundaries of the Bayesian Credible Interval around the 20 th ile regression line

The annual egg deposition, CL and MT for the Severn salmon stock for the last ten years are presented in **Figure 4** below. The stock assessment indicates that the Severn salmon stock has only exceeded its CL in three of the last ten years, declining since 2015, to now only achieving a little over 50% of the CL in 2019.

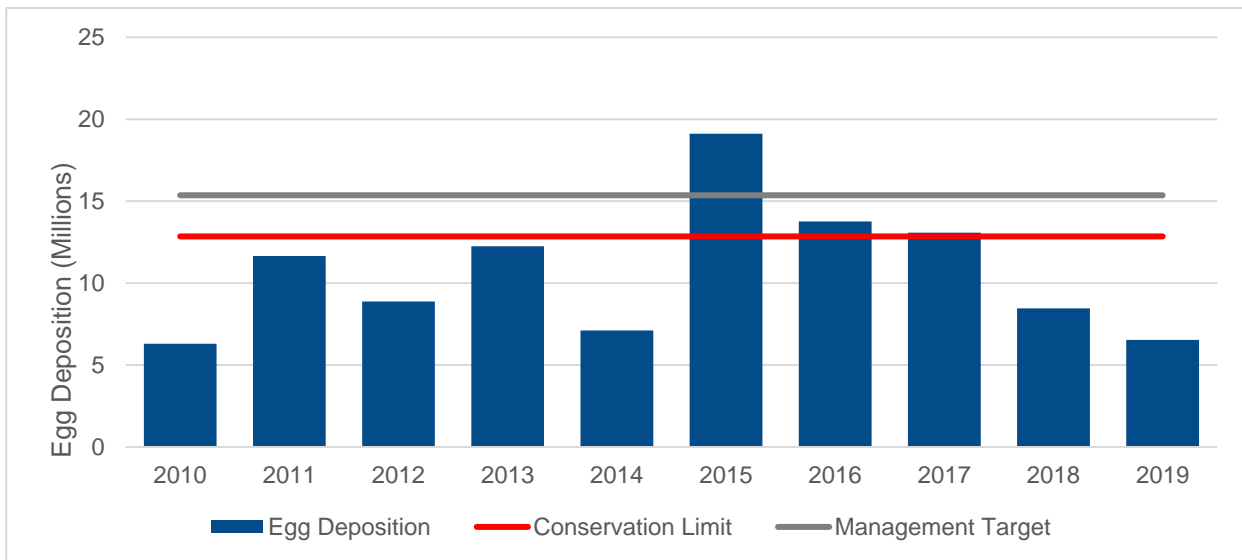


Figure 4 Egg deposition estimates relative to the conservation limit and management target for the River Severn between 2010 and 2019

Severn salmon stock assessments had been on an improving trend up to 2017, being classified as ‘Probably Not at Risk’ at that time. However, stock assessments in 2018 and 2019 show the classification has declined to the ‘Probably at Risk’ category, and the ten-year trend is now declining slightly. There is currently no harvestable surplus of salmon that can be taken by the Severn fisheries and there is a risk of failing to meet the CL in the future. The current egg deposition equates to 875 spawning adult females. The number of spawning females equivalent to the CL is 1720, indicating a shortfall of 845 spawning females in 2019. The position of the 20%ile trend line in relation to the CL is key in determining the risk category of the stock and the consequent management action defined in the Decision Structure for that risk category. In this case the 20%ile trend line identifies the Probably at Risk status of the Severn salmon stock and represents a spawning deficit of over 1055 spawning females in 2019, with slightly larger deficit (1100 spawning females) projected in 2024 if the prevailing trend continues.

River Wye and River Usk salmon stock assessments

The respective salmon stock assessments for the River Wye and River Usk SACs are shown in **Figure 5** below.

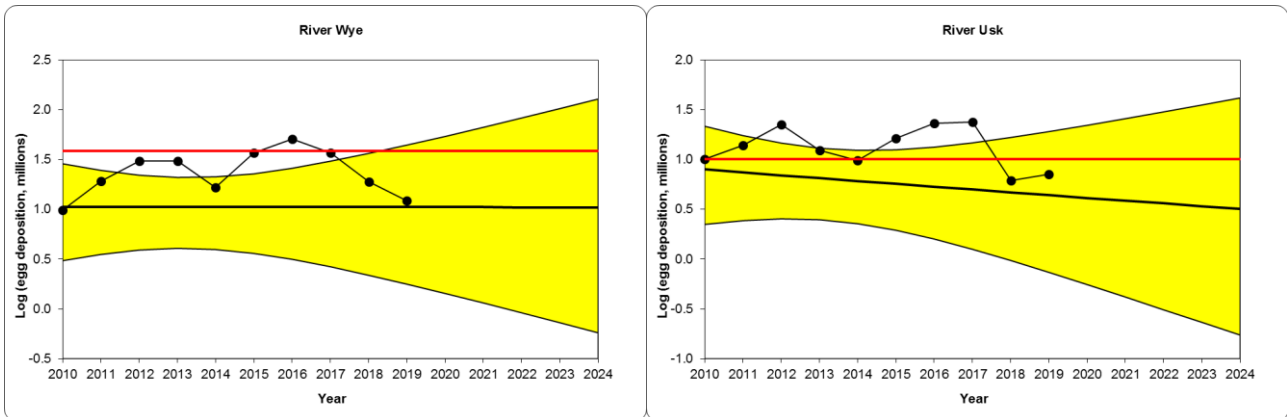


Figure 5 River Wye and Usk compliance against the MO, 2019.

Both the Wye and Usk salmon stocks are also now classified as being 'Probably at Risk' of failing the MO in the 2019 assessment and are both predicted to remain so in five years' time.

To summarise, the 2019 stock assessments for the Severn, Wye and Usk now classify all three rivers in the "Probably At Risk" category, and all are projected to remain in this category in five years' time. There is no harvestable surplus of salmon from any of these stocks. The Severn salmon stock realised only 66% and 51% of its CL level in 2018 and 2019 respectively, indicating substantial shortfalls in the spawning stock in both years, with the 20%ile trend also representing a substantial shortfall in spawning stock.

3 Current status of salmon stocks

3.1 Introduction

Annual salmon stock estimates are primarily based upon the annual declared rod catch, which provides important data in terms of the numbers of salmon captured, weight of salmon captured and the level of effort that has been used by anglers to capture these fish. These data are available for all principal salmon rivers in England and Wales and provide an invaluable means to monitor salmon stock health and performance. Rod catch data may also be supplemented with data from index river catchments, automated fish counters or traps, as well as net fishery catch data, and juvenile surveys that are undertaken regularly on all principal salmon rivers.

In line with NASCO guidance, where there is uncertainty in any aspect of the salmon stock assessment process, it is considered necessary to take a precautionary approach towards the management of the stock and the fishery. The overriding objective is to ensure that the salmon stock remains at healthy, sustainable levels, exceeding the CL. If the CL is achieved on a regular basis, this provides greater confidence that the stock is capable of supporting rod and net fishery exploitation. The national salmon stock assessment process provides a consistent means of defining and comparing salmon stock performance over the last ten years. Any consequent need for management measures is based upon the national salmon management decision structure (Appendix 1). The current process has been in place in England and Wales since 2003 and has been utilised for salmon fisheries management and reviews of fishery byelaws and regulations since that time. Most recently, the method has been used to implement more protective netting and angling regulations both locally and nationally in response to declining stocks, including:

- Mandatory C&R of salmon by the net and rod fisheries in the Solway, River Eden and Border Esk (May 2018),
- National byelaws in England to prohibit certain types of net fishing and to require mandatory C&R for certain nets, as well as mandatory C&R for rod fisheries on specific rivers with At Risk or Recovering stocks (Dec 2018)
- National byelaws in Wales (Jan 2020) requiring mandatory C&R and method restrictions for all rivers. The appropriateness of these byelaws was scrutinised through Welsh Government Local Inquiry, and were found to be necessary, proportionate and reasonable (Beggan, 2019).
- Cross Border byelaws (Jan 2020 Wales & Jun 2020 England) for the Rivers Wye and Dee to apply mandatory C&R and method restrictions.

Detailed rod and net catch statistics are available for the Severn fisheries dating back to 1951. An automated resistivity fish counter on the River Tanat, an important salmon spawning tributary on the upper Severn, has continuously provided returning stock estimate data since 2010. The time series of counter data, which is independent of the rod fishery catch data, enables us to compare monthly and annual changes in fish migration at this site. Importantly, the counter data also provides a useful annual index of salmon stock performance within the whole Severn catchment.

Juvenile salmon monitoring is undertaken regularly throughout the main salmon spawning areas within the River Severn catchment. These data provide a useful time series that indicates the changing distribution of adult spawning, the abundance of juvenile salmon recruitment and an indication of likely future smolt output.

While this document largely focusses specifically on the salmon stocks and the fisheries that they support on the River Severn, it is useful to initially consider these data in the

wider context of the long term catch records of all of the rivers that enter the Severn estuary i.e. the Wye, Usk and Taff and the now closed net fisheries of the River Parrett, as presented in **Figure 6**, below. As recently as the 1980's, the combined total declared catch of salmon by these rod and net fisheries averaged over 10,500 salmon per year. These will have largely all been harvested, as C&R fishing was not common at that time. In comparison, the total declared catch for the last ten years has been 2,100 salmon per year, and the total declared catches in 2018 and 2019 have been the lowest on record, both less than 1,000 salmon (917 and 607, respectively).

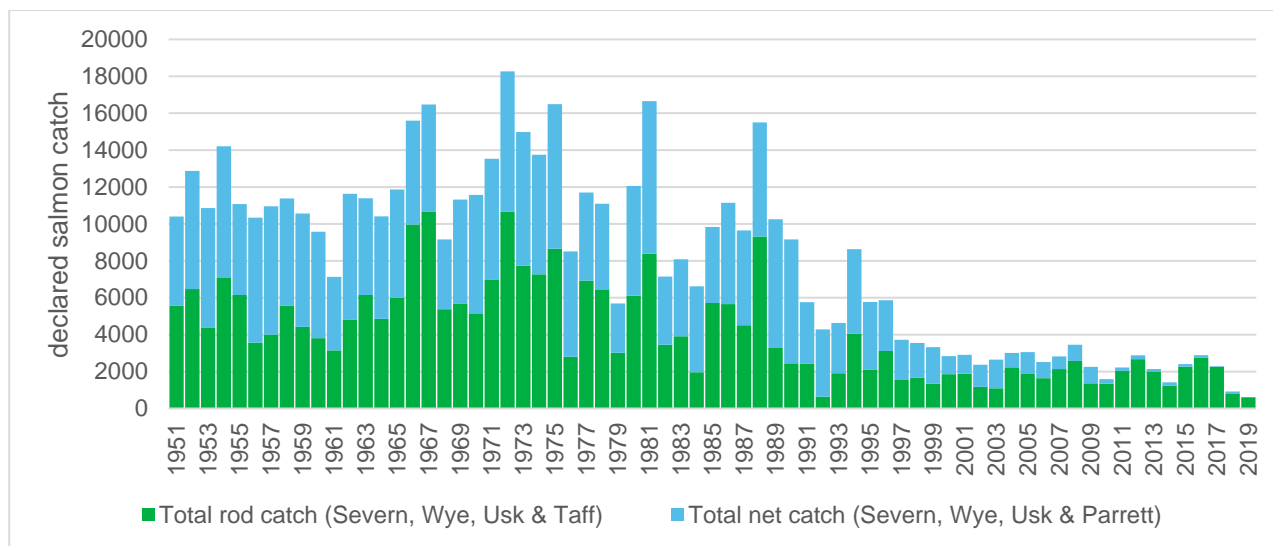


Figure 6 Total rod catches (Severn, Wye, Usk & Taff) and net catches (Severn, Wye, Usk and Parrett) of salmon from 1951 to 2019.

3.2 Rod fishery catches

3.2.1 Declared catches

The declared rod catch data for the Severn between 1951 and 2019 are presented in **Figure 7** below.

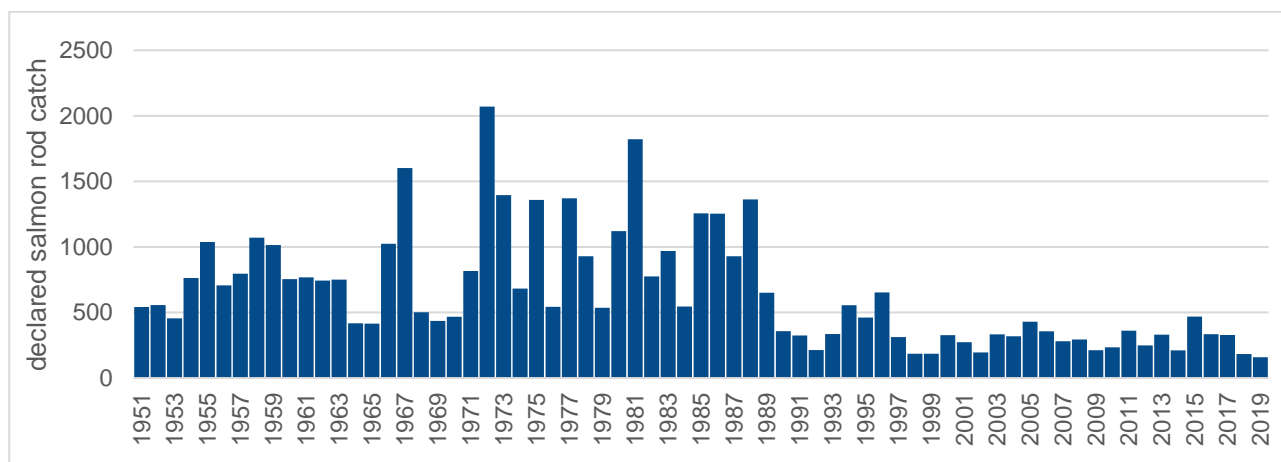


Figure 7 Declared rod catch for the Severn between 1951 and 2019

Prior to 1989, the River Severn declared rod catch averaged 902 salmon per year (ranging from 415 in 1965 to 2071 in 1972). From 1989 to present, the declared rod catch has averaged 320 per year (ranging from 159 in 2019 to 653 in 1996). The low rod catch (159) in 2019 seems particularly worrying, given generally better fishing conditions being

available, compared with the drought year of 2018 (183 rod catch). Monthly rod catches for the last twenty years are presented in **Figure 8**, below. The distribution of catches over the months within the fishing seasons have changed, with slight improving trends apparent in catches during April, May and June, but declining catches apparent in July, August, September and October.

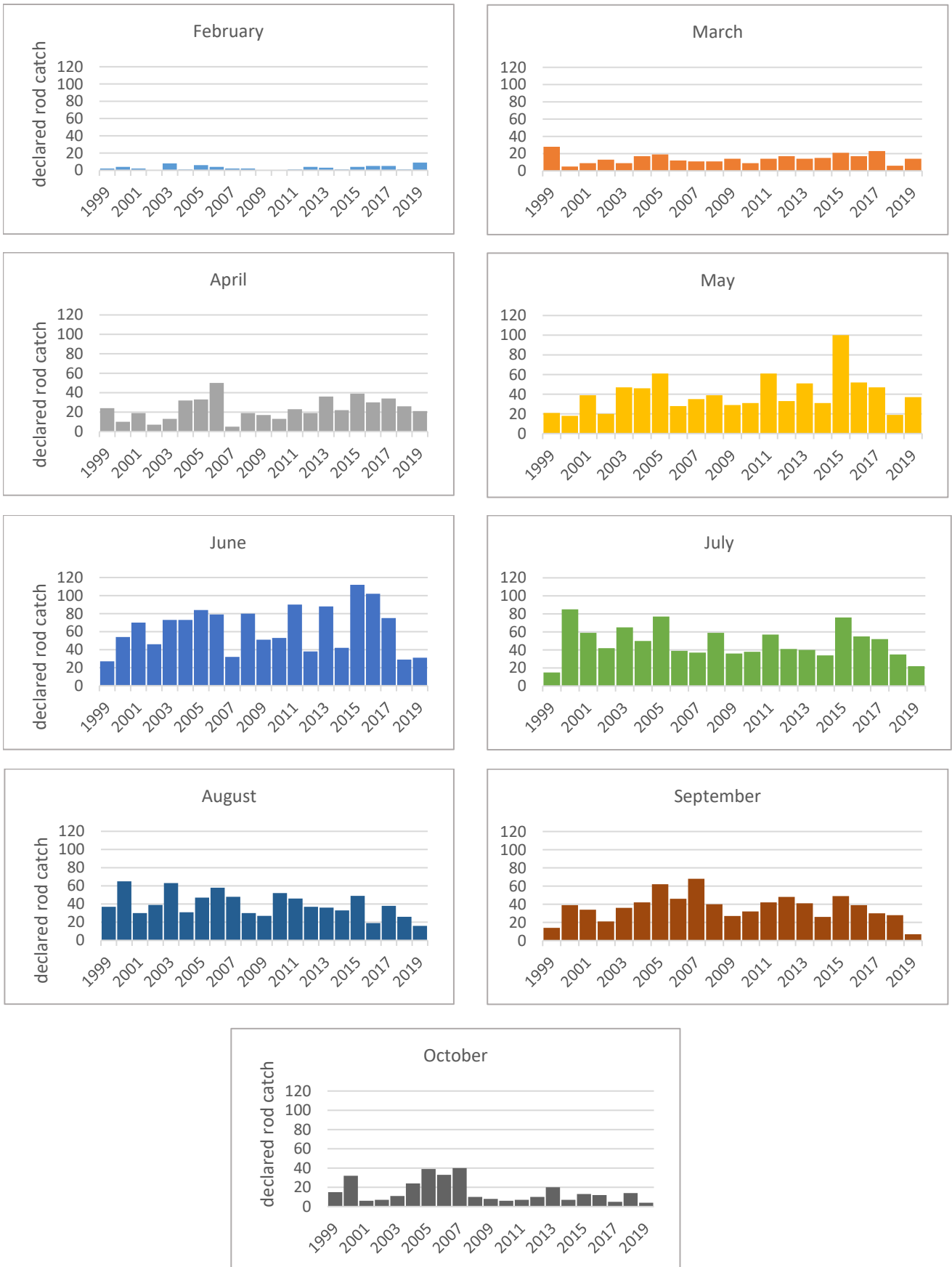


Figure 8 – Severn monthly rod catches (1999 to 2019)

3.2.2 Catch and Release

Mandatory catch and release (C&R) of all salmon captured on the River Severn applies prior to 16 June every year since the introduction of the national spring salmon byelaws in 1999, and renewed in 2009 and 2018. The annual C&R rate over the full rod fishing season and the voluntary rate of C&R for the remainder of the fishing season after 16 June (to 7 October) are presented in **Figure 9** below.

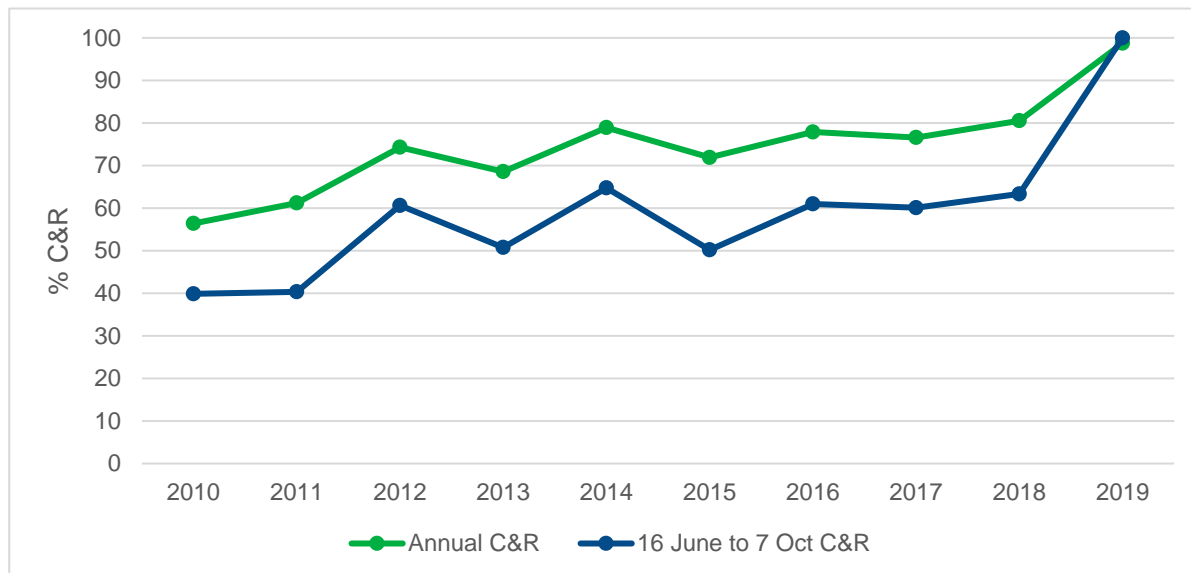


Figure 9 C&R rates for the rod fishery in the River Severn between 2010 and 2019. The green line shows the rate for the entire season, the blue line shows the rate for voluntary C&R 16th June to 7th October.

The overall (voluntary and mandatory) annual C&R rate of salmon by the Severn rod fishery has increased from 56% in 2010 to 81% in 2018 and 99% in 2019. The high annual C&R rate observed in 2019 reflects the introduction of the emergency River Severn salmon protection byelaws in 2019 that required the mandatory C&R of all salmon throughout the full season. It should be noted that 2 salmon were reported as being taken in June 2019 despite the emergency salmon protection byelaw being implemented at that time. The rate of voluntary C&R post 16th June was previously relatively poor, at 40% up to 2011. This voluntary C&R rate varied between 50 and 63% from 2012 to 2018. The Severn rod fishery records one of the lowest voluntary C&R rates of any of the principal salmon rivers in England and Wales, despite attempts by the Environment Agency over a number of years to encourage voluntary restraint in the taking of salmon from the rod fishery when more stringent measures were being applied to the net fishery.

3.2.3 Methods of capture

The percentage of the annual catch taken by the different angling methods from 2010 to 2019 is presented in **Figure 10** below. Spinning accounts for the largest share (63% avg) of the catch in each of the last ten years, with bait fishing accounting for the next share (29% avg), and fly fishing accounting for the least (7% avg) share of the catch.

The percentage of the total salmon catch taken by spinning has gradually increased since 2010, while the percentage of salmon taken by bait has decreased. The proportion taken by fly has remained broadly the same throughout the same period. National Salmon byelaws introduced in 1999 and renewed in 2009 and 2018, (often referred to as Spring salmon byelaws), prohibit bait fishing prior to 16th June, while both fly and spinning methods are permitted throughout the season.

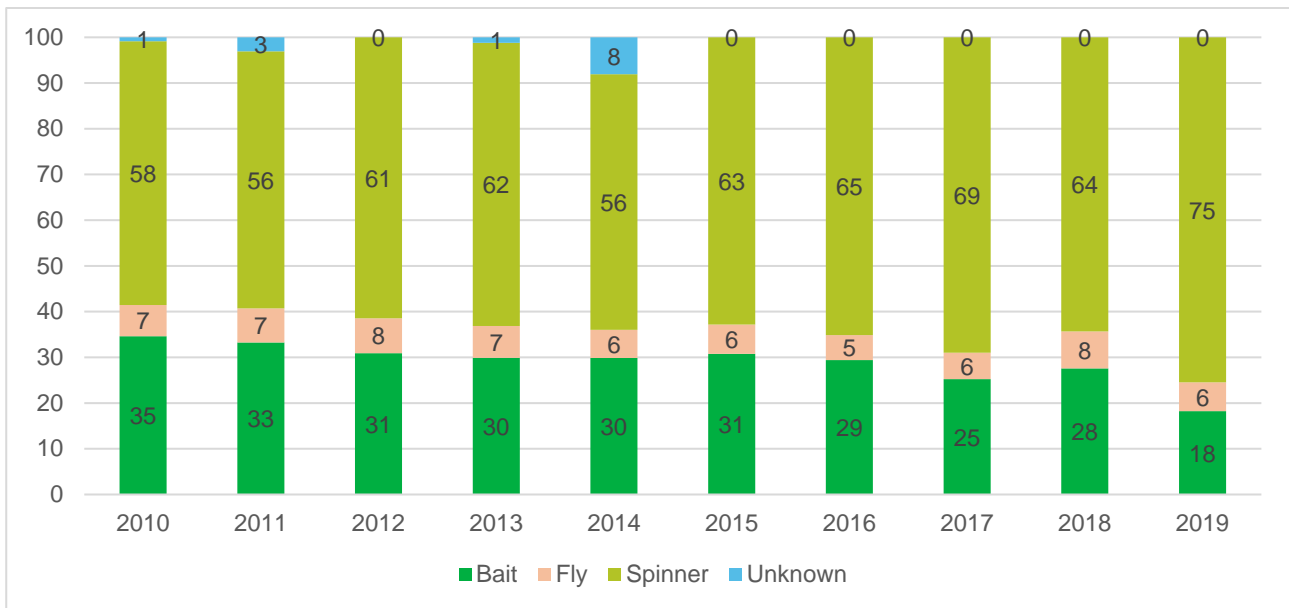


Figure 10 Proportion of catch taken by the three methods between 2010 and 2019. The proportions for each method are shown by the values within the bars.

Of the fish declared caught on spinner over the last five years, 87% were released and of the fish declared caught on bait, 55% were released, and of those caught on fly, 89% were released. The reduced level of C&R observed for bait fishing may reflect the fact that salmon taken on worms tend to be deeply hooked and therefore in poor condition to be returned alive.

At the time of the emergency byelaws on the Severn fisheries taking effect in June 2019, some concern was raised by rod fishing interests that method restrictions, particularly restricting the use of worm, were not proposed to maximise the survival of rod-caught salmon. Therefore angling method and bait restrictions have been considered here as part of the future options for managing the rod fishery.

Several options relating to fishing method restrictions have either been applied or have been considered for application to other rod fisheries nationally in recent years. The national spring salmon byelaws already restrict the use of bait fishing prior to 16th June each year in combination with mandatory C&R fishing. Other salmon rod fisheries in England also have various angling method restrictions in place reflecting the risk that these methods pose at a local level.

NRW has recently imposed more comprehensive method restrictions including bait and hook size restrictions which apply from January 2020 onwards, in combination with mandatory C&R regulations. In addition to these regulations, a number of C&R best practice guide leaflets and videos are widely available.

A review of the impacts of C&R angling on salmon survival (Cowx *et al* 2017) identified the following key factors affecting the survival of released fish:

- Fishing method – bait, specifically worm, hooked fish tend to be more deeply hooked and more prone to damage and bleeding that reduces their chances of survival after release. The Flying C type of spinner is also recognised to be associated with deep hooking, and lower survival rates of fish following release.
- Hook size and type – larger hooks tend to be more damaging than smaller hooks. Treble hooks and double hooks tend to be more damaging than single hooks, and barbless hooks are usually less damaging and less difficult to remove than barbed hooks.

- Air exposure – the longer a fish is exposed to air while being unhooked, the more likely it is to not survive. Best practice guidance encourages anglers to use barbless and/or single hooks in order to minimise handling time and also encourages anglers not to remove fish from the water.
- Water temperature – studies show that fish caught in higher water temperatures, 17-18°C and above can result in higher mortalities.

<https://www.gov.uk/government/publications/impact-of-catch-and-release-angling-practices-on-survival-of-salmon>

3.2.4 Rod fishing effort

The number of submitted rod catch returns (that include a record of fishing effort) over the period 2010 to 2019 are presented in **Figure 11**. In addition, the total number of fishing days recorded for each season, and the corrected total catch associated with those catch returns that included a measure of fishing effort, are also included.

The number of catch returns (that include a measure of fishing effort) submitted by River Severn anglers has generally declined over the period from around 350 initially to 200 or less in the last 2 years. Equally, the number of days fishing recorded (note that a fishing “day” should be recognised as a fishing event rather than a specific timed duration) has also declined over the period, from around 5000 days initially to around 2500 days in the last two years.

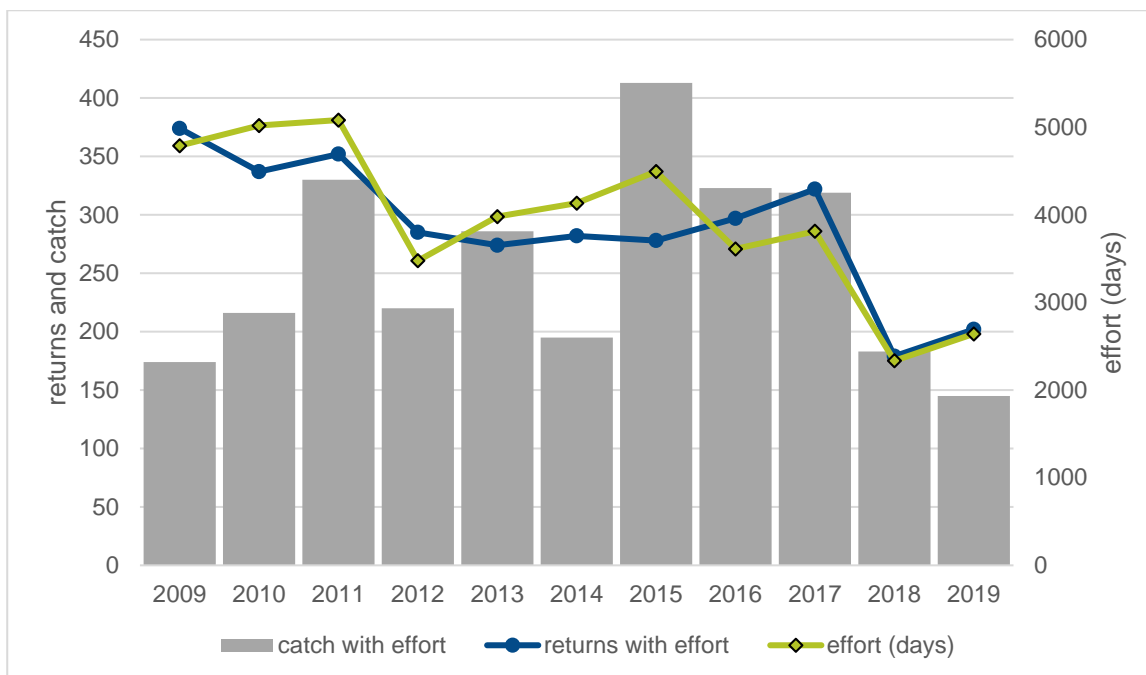


Figure 11 Number of rod catch returns submitted (that include fishing effort data) and recorded fishing effort (“days”) for the Severn salmon fishery, 2010 to 2019. Rod catch from these catch returns (that include fishing effort) is also presented. Note that this catch statistic is usually lower than the published total declared catch each year due to some catch returns not including their record of fishing effort data. (catch with effort represents ~92% of declared catch)

3.2.5 Distribution of retained catch amongst anglers

The distribution of the kill of salmon amongst anglers is shown in **Figure 12**. This presents the number of anglers killing 0, 1, 2 or more than 2 of the salmon that they caught within each fishing season. Note that this graph does not include those anglers who recorded catching no salmon – only those who caught salmon. The number of anglers that killed none of the salmon they caught ranged from 27 to 45 over the 10-year period, averaging

34. The numbers of anglers retaining 1, 2 or more salmon per year have declined. An emergency byelaw requiring mandatory C&R of all salmon was in place for the 2019 fishing season, although two anglers declared they had each killed one salmon. The majority of the salmon being killed in recent years, are taken by individual anglers who are only killing a single salmon. In the context of reducing the rod fishing mortality of salmon, introducing potential bag limits of one or two salmon per angler per season would have negligible benefit to the Severn salmon stock. The most effective means of reducing rod fishing salmon mortality would be delivered through reducing the number of individual anglers who are killing one or more salmon per season.

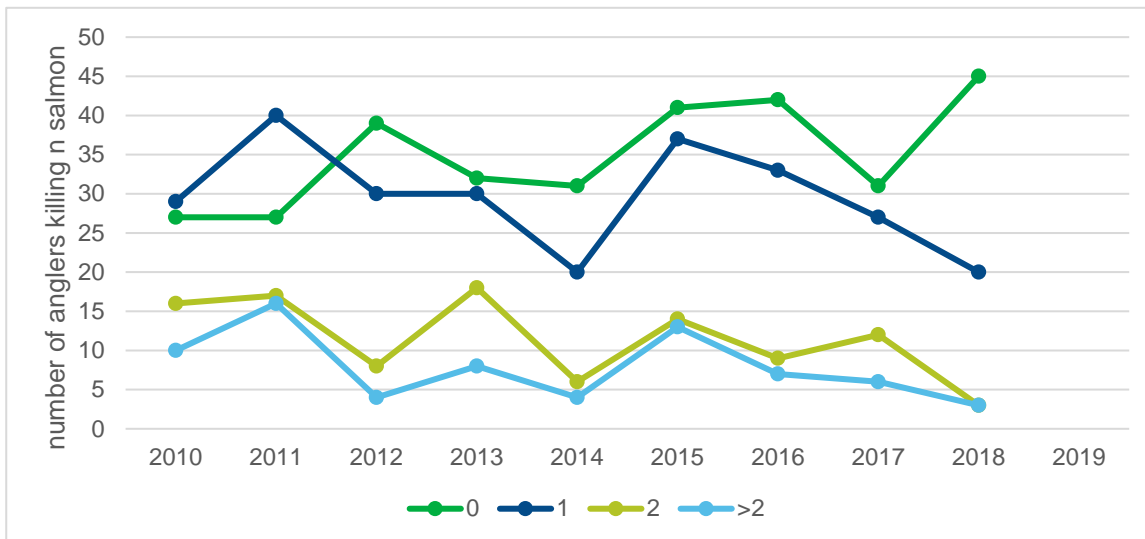


Figure 12 Number of anglers killing 0, 1, 2 or >2 salmon per season 2010 to 2019

3.2.6 Rod fishing mortality

Salmon mortality in the Severn rod fishery is attributable to two main sources; the direct killing of salmon, and the subsequent mortality of salmon associated with C&R fishing. The distribution of these sources of mortality from 2009 to 2019 are presented in **Figure 13** below. In the five years prior to the implementation of emergency byelaws which included mandatory C&R for rod anglers in 2019, the retention of salmon ranged from 36 to 129 salmon per year, while the C&R mortality ranged from 30 to 68 salmon per year.

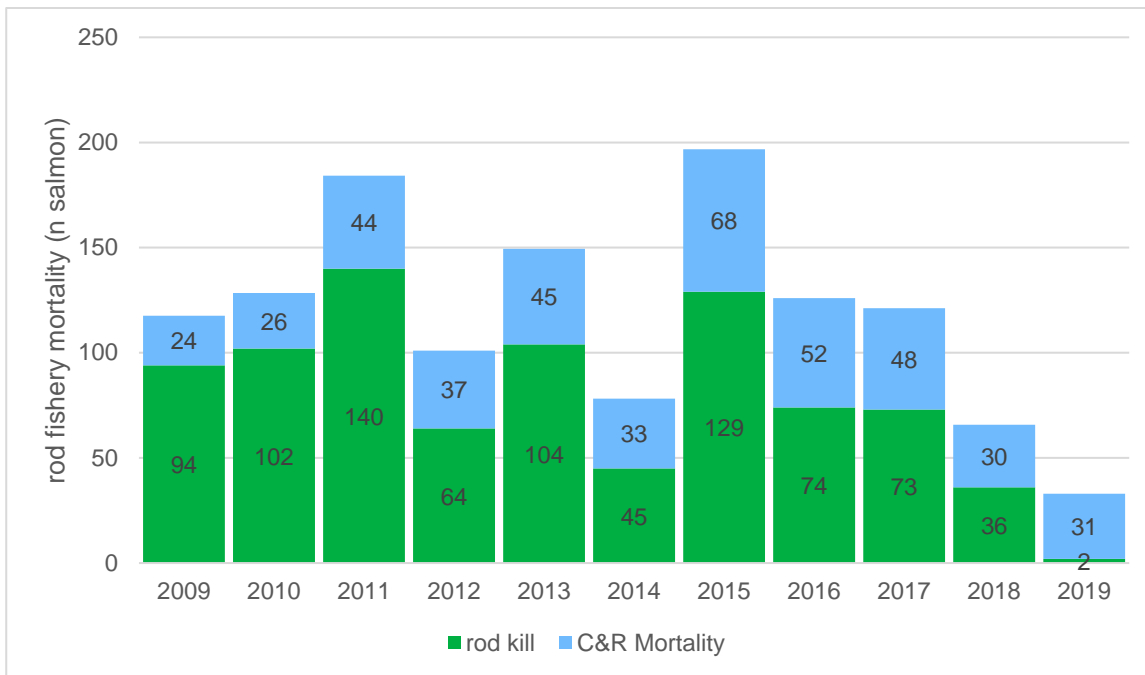


Figure 13 Sources of salmon mortality for the Severn rod fishery 2009 to 2019

The introduction of mandatory C&R byelaws on the River Severn would eliminate any direct kill of salmon, although an estimated 20% of those fish being released may still be lost as a consequence of post C&R mortality. A mandatory C&R byelaw in combination with fishing method restrictions, to reduce C&R mortality and therefore improve the survival of released fish, would be likely to deliver the greatest benefit for the Severn spawning stock at this time, in the range of an additional 30 to 100 salmon surviving the rod fishery to spawn, based on recent reported catches.

Voluntary efforts to increase C&R fishing have clearly improved but actually remain relatively low compared to other rivers. The most effective means of reducing rod fishing mortality would be delivered through reducing the number of individual anglers who are killing one or more salmon per season. Spinning accounts for the largest proportion of the annual catch, with bait being the next most prevalent method. The adoption of less damaging fishing methods would minimise the number of salmon experiencing C&R mortality. Mandatory C&R in combination with byelaw fishing method restrictions would deliver the greatest potential savings from the rod fishery at this time. However, such measures on their own would only compensate for a fraction of the current deficit in spawning stock/egg deposition.

3.3 Net fishery catches

Declared Severn estuary net and fixed engine salmon catch data from 1951 to 2019 are presented in **Figures 14 to 16** below. Graphs are presented on the same scales to illustrate the relative impact of all three fishing methods.

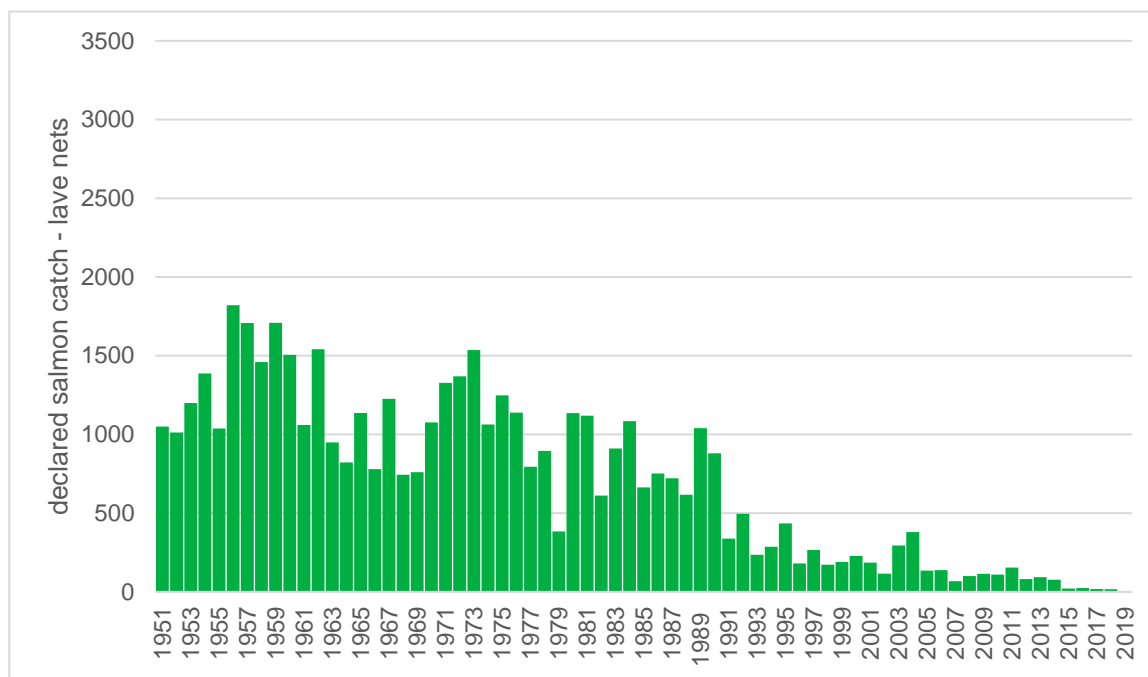


Figure 14 Severn estuary lave net salmon catches between 1951 and 2019 (Note that regulations have variously reduced the number of lave net licences, reduced the available netting season and since 2012 applied limits to the number of salmon that may be killed).

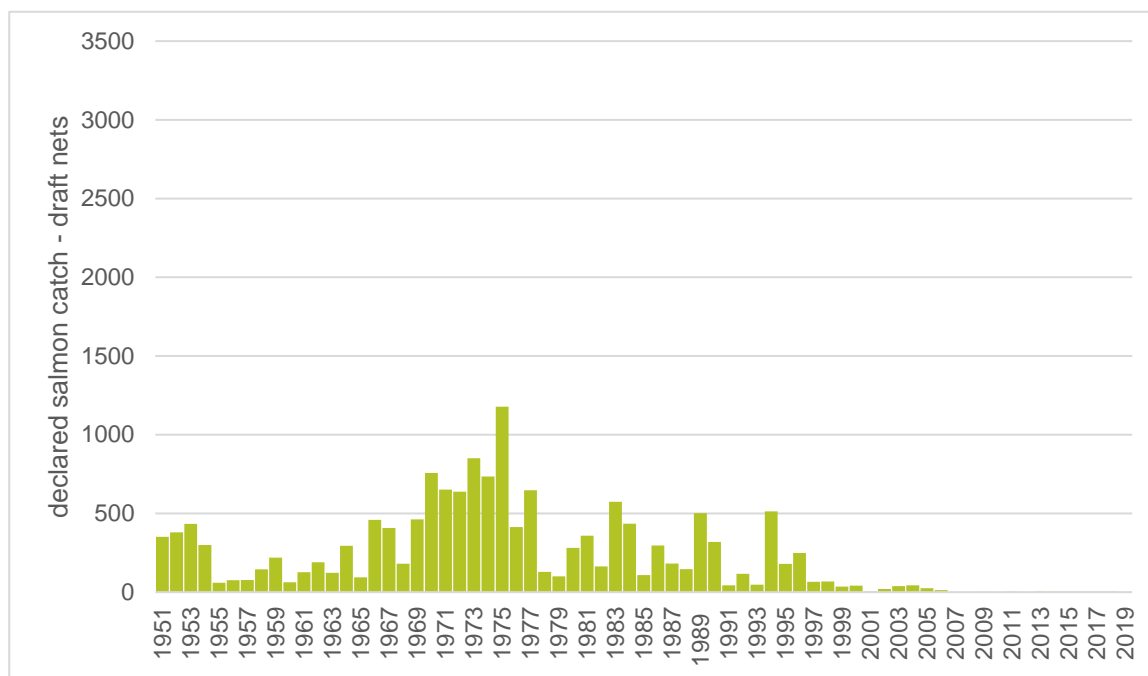


Figure 15 Severn estuary draft net salmon catches between 1951 and 2019 (Note that regulations have variously reduced the number of draft net licences, reduced the available netting season and since 2012 applied limits to the number of salmon that may be killed)

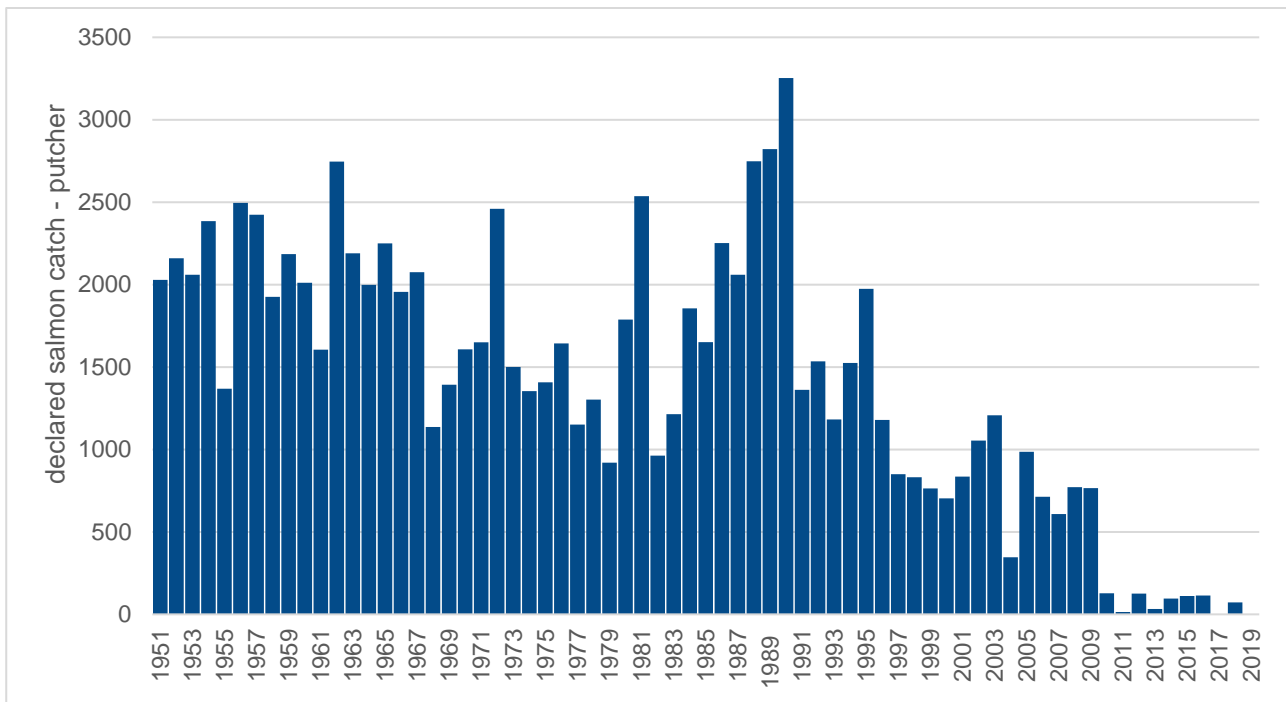


Figure 16 Severn estuary putcher salmon catches between 1951 and 2019 (Note that the number of active putcher ranks has voluntarily reduced while regulations have also reduced the available netting season and since 2012 applied limits to the number of salmon that may be killed)

Net catches of salmon have been dominated by the fixed engine, putcher rank method. Lave nets account for the next largest component of the catch while draft nets account for the smallest share of the catch. While it is clear that catches of salmon to all three methods have reduced markedly in recent years, it is important to recognise that all three methods have been progressively restricted through limits placed on licences to reduce their impact on the exploited adult salmon stocks.

The impact of the estuary net fisheries on the relevant stocks has been managed annually since 2012 through the application of a Total Allowable Catch (TAC). Importantly, the TAC allocation has not been fully utilised in each of the last 7 years when these fisheries have operated (Table 2 below).

Table 2 Total Allowable Catch (TAC), allocation to the three net gears and respective declared catches in brackets.

Year	Total Allowable Catch (TAC) number of salmon	Lave allocation (declared catch*)	Draft allocation (declared catch*)	Putcher allocation (declared catch)	Declared Catch percentage of TAC
2012	297	145 (81)	2 (0)	150 (126)	70%
2013	278	135 (93)	5 (5)	138 (33)	47%
2014	294	145 (77)	5 (5)	144 (96)	61%
2015	157	27 (21)	3 (3)	127 (111)	90%
2016	166	26 (24)	4 (4)	136 (114)	87%
2017	183	25 (18)	4 (4)	154 (0)	16%
2018	188	22 (17)	4 (4)	162 (72)	52%

*Declared catch that has been retained does not include fish that may have been returned and reported declared catch elsewhere.

Stock assessments for the three rivers exploited by the estuary fisheries, were improving up to and including 2017. However all three stocks have failed to achieve their respective CLs in 2018 and 2019, recording substantial deficits in spawning stock in those years and are now demonstrating slight declining trends. Tagging studies have demonstrated that the majority (approx. 90%) of salmon taken by the estuary net fisheries have been destined to return to the rivers Wye and Usk, with the remaining approximate 10% being destined for the Severn. Potential reductions in the number of salmon taken by the estuary fisheries will therefore deliver a relatively small benefit for the Severn, but greater benefits for the spawning stocks of the Wye and Usk SACs. Given this share of the estuary catches between the three rivers, the potential prohibition of killing salmon by these fisheries would generally save less than 20 salmon per year for the Severn, based on recent catch levels.

The continued application of a TAC for managing the impact of the net fisheries is no longer compatible with the need to reduce salmon exploitation for the Severn, Wye and Usk stocks, given the substantial deficit in spawning stocks/egg depositions in recent years. The potential prohibition of killing salmon by the net and fixed engine fisheries would deliver immediate savings for the spawning stocks of the Severn, Wye and Usk, but on their own these savings would be relatively modest and not sufficient to fulfil the current deficits in spawning stocks/egg deposition for each of these rivers.

3.4 River Tanat resistivity fish counter data

The fish counter at Carreghofa on the River Tanat has provided a validated estimate of the adult salmon run into this important upper Severn spawning tributary since 2010 (**Figure 17**). While this counter has been operational since 2003, the data prior to 2010 were not video validated to confirm the counter accuracy or the species of fish being recorded, and therefore cannot be interpreted as total annual salmon runs in these years.

The validated count of salmon increased from 343 salmon in 2010 to 638 in 2015, but the validated counts in 2017 and 2018 have been the lowest on record. The 2016 and 2019 counts represent minimum estimates only, so cannot be directly compared with the rest of the data here. Nonetheless, the validated counts in 2017 and 2018 indicate a substantial reduction in the number of spawning adult salmon entering this particular stream.

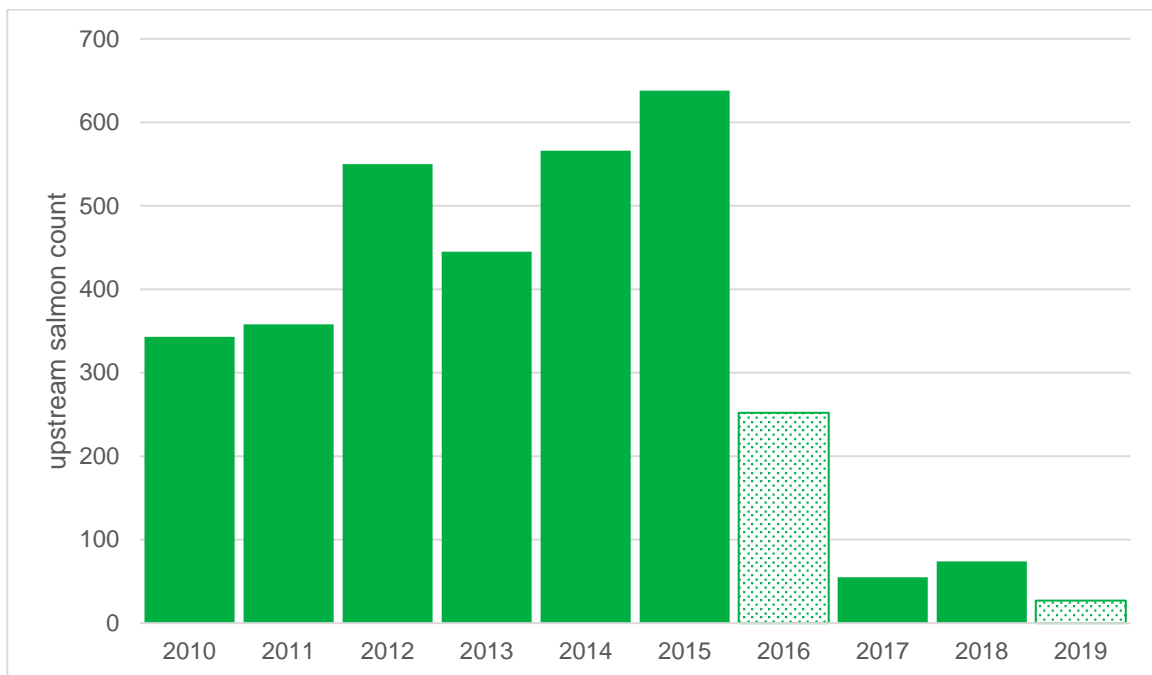


Figure 17 Validated upstream counts of adult salmon recorded from the fish counter at Carreghofa on the Afon Tanat, 2010 to 2019. (Note that the 2016 and 2019 counts are minimum estimates.)

The upstream salmon counts for the Tanat counter each month are presented below in **Figure 18** below.

Whilst there is clear variation between years and months, there is a general pattern of quite low runs, averaging less than 10 salmon during January to March, slightly higher runs during May and June, averaging 30 to 40 fish, followed by low runs again in July, August and September, averaging around 10, before a larger and more distinct peak in migration at this site during October and November, averaging over 100 salmon prior to 2016. It is evident that this pre-2016 strong autumn peak in salmon migration has been markedly reduced in 2017 and 2018.

Figure 18 Validated monthly salmon monthly up counts recorded from the fish counter at Carreghofa on the Afon Tanat, 2010 to 2019. ★ Denotes power failure or unvalidated counts



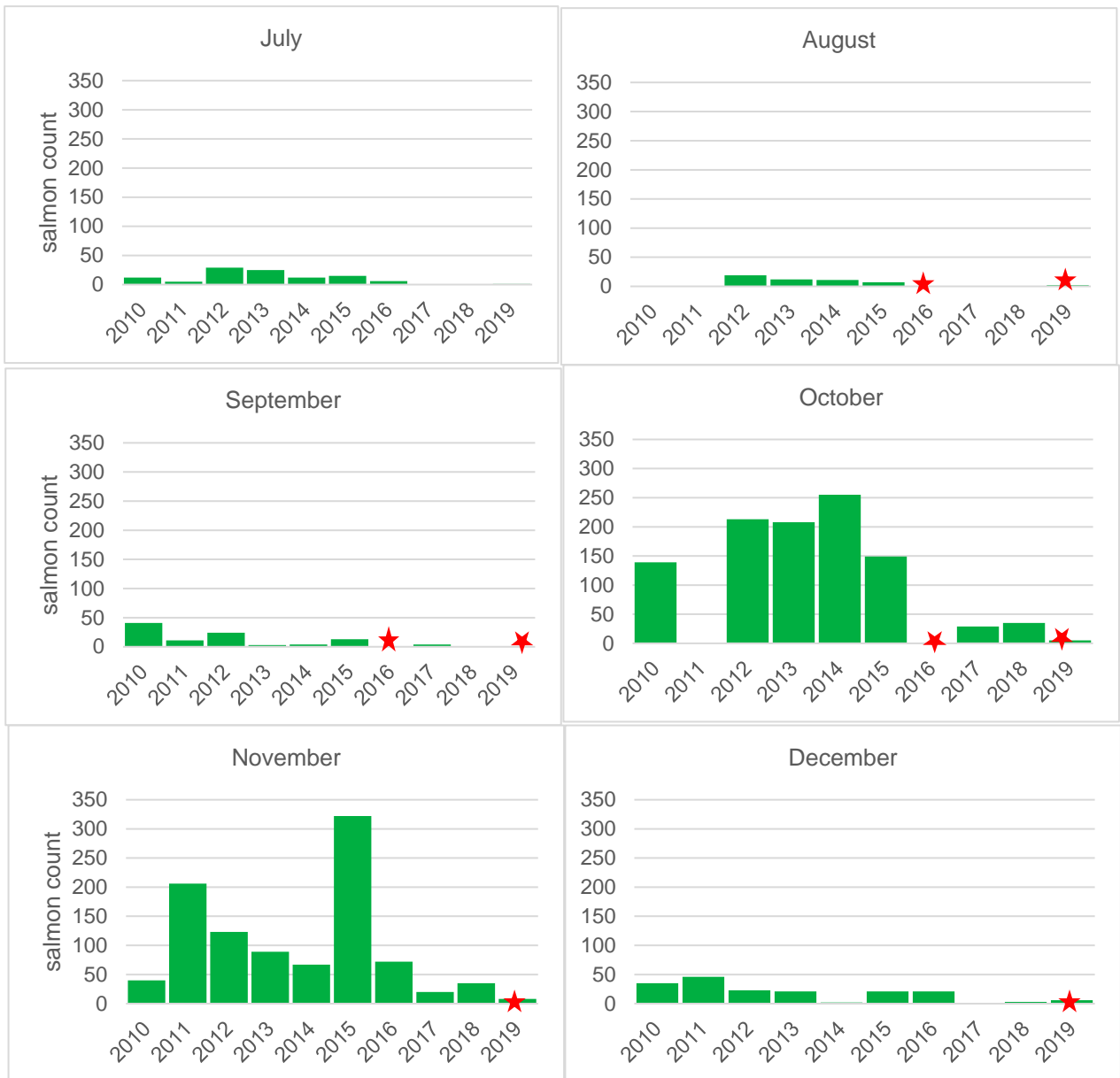


Figure 18 contd Validated monthly salmon monthly up counts recorded from the fish counter at Carreghofa on the Afon Tanat, 2010 to 2019. ★ Denotes power failure or unvalidated counts

The validated counts for the River Tanat demonstrate a broadly improving trend from 2010 to 2015, but substantially reduced counts in 2017 and 2018. Markedly reduced pre-spawning runs are evident during October and November in these two recent years.

3.5 Juvenile salmon survey data

The juvenile salmon survey provides a valuable description of the distribution and abundance of juvenile salmon in the catchment over recent years, including how that distribution and abundance has changed.

3.5.1 2019 juvenile survey data

The abundances of salmon fry and parr (expressed as National Fisheries Classification Scheme (NFCS) grades), and their distribution in the 2019 survey are presented in Figure 19. The salmon fry and parr densities that equate to the respective NFCS grades are presented in **Table 3** below. Sites are classified into categories A to F, depending on densities of juvenile salmonids at the site, grade A representing the highest abundance for a fishery of this type, grade E representing the lowest abundance and grade F representing the absence of the species/age class at the site.

Table 3 NFCS grades in relation to densities (no/100m²) of juvenile salmon

Grade	Salmon	
	Fry (0+)	Parr (>0+)
A	>86	>19
B	45-85	10-18
C	23-44	5-9
D	9-22	3-4
E	<9	<3
F	0	0

The NFCS grades for the 2019 survey are relatively low, with grades C, D and E dominating the results, and two sites recording a complete absence of salmon fry and parr (grade F). No sites in the catchment have recorded the two highest grades A or B for either salmon fry or parr.

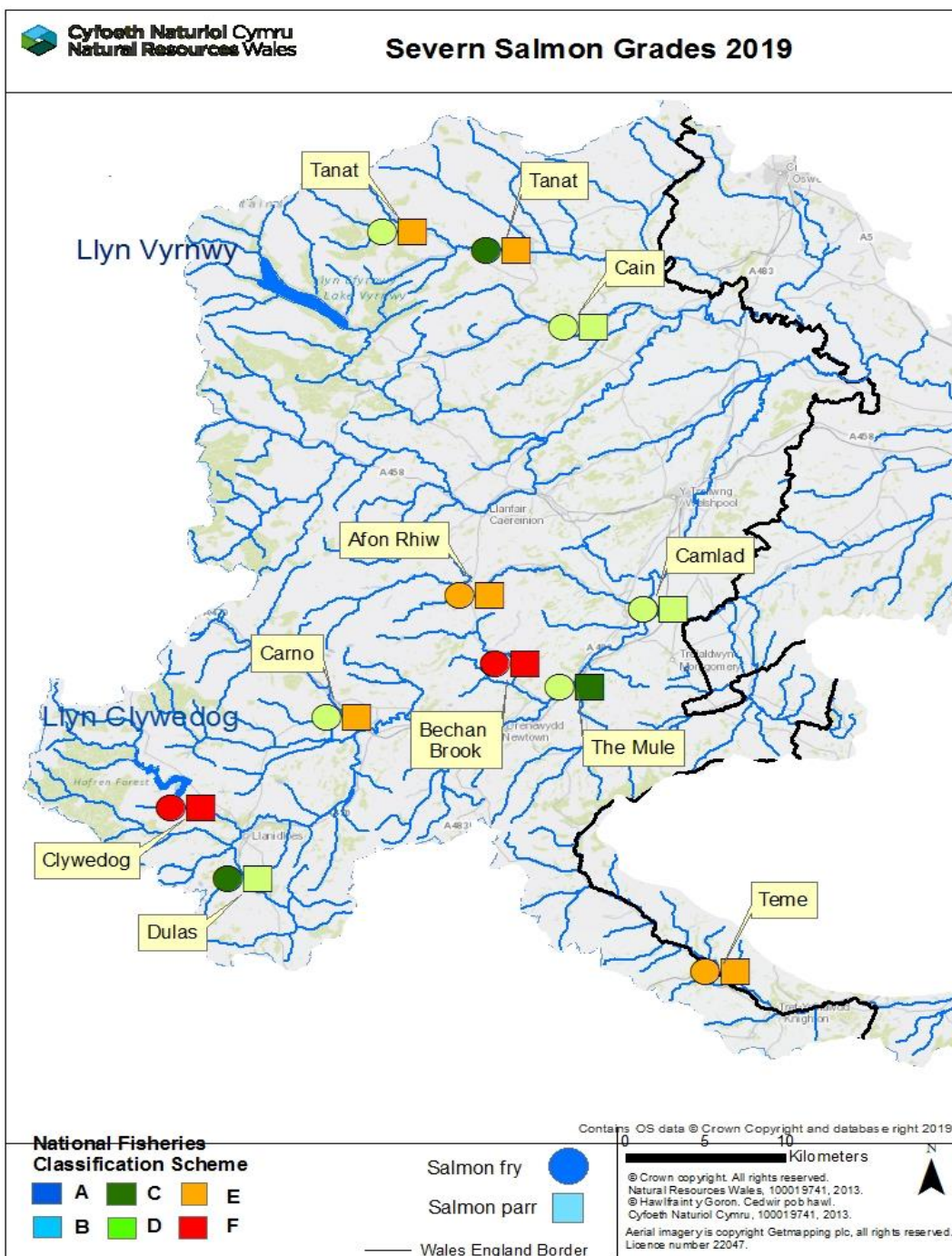


Figure 19 Upper Severn, Vyrnwy and Upper Teme catchment juvenile salmon classification grades in 2019. Data provided by NRW

3.5.2 Changes in juvenile salmon abundance over time

Average salmon fry and parr densities from 2012 to 2019 from Upper Severn surveys are presented in Figure 20 below.

Average salmon fry (0+) densities at Severn sites tend to be relatively low, rarely exceeding 20 fry per one hundred square metres of stream. The average fry density in 2016 was markedly reduced from that recorded in previous surveys, and was speculatively attributed to extensive and severe flooding and unseasonably mild winter water temperatures associated with Storms Desmond, Eva and Frank in December 2015. Similar

reductions in salmon fry densities were observed in other catchments in 2016. Average fry densities in 2017 and 2018 were markedly improved from the low of 2016, and were the two highest recorded values in the eight-year time series. The 2019 average fry density was the lowest value on record. This low average density could not be readily associated with any obvious flood or temperature impacts, and is most likely attributed to the lack of spawning adult salmon from the poor 2018 run.

Average salmon parr densities have also been relatively low across the Severn catchment in these surveys, rarely exceeding three parr per one hundred square metres of stream. The average parr density in 2017 was one of the lowest on record up to that time, likely reflecting the poor average fry density from the preceding year. While the 2018 average parr density was higher than in the previous years' survey, the 2019 average was the lowest recorded from all eight surveys.

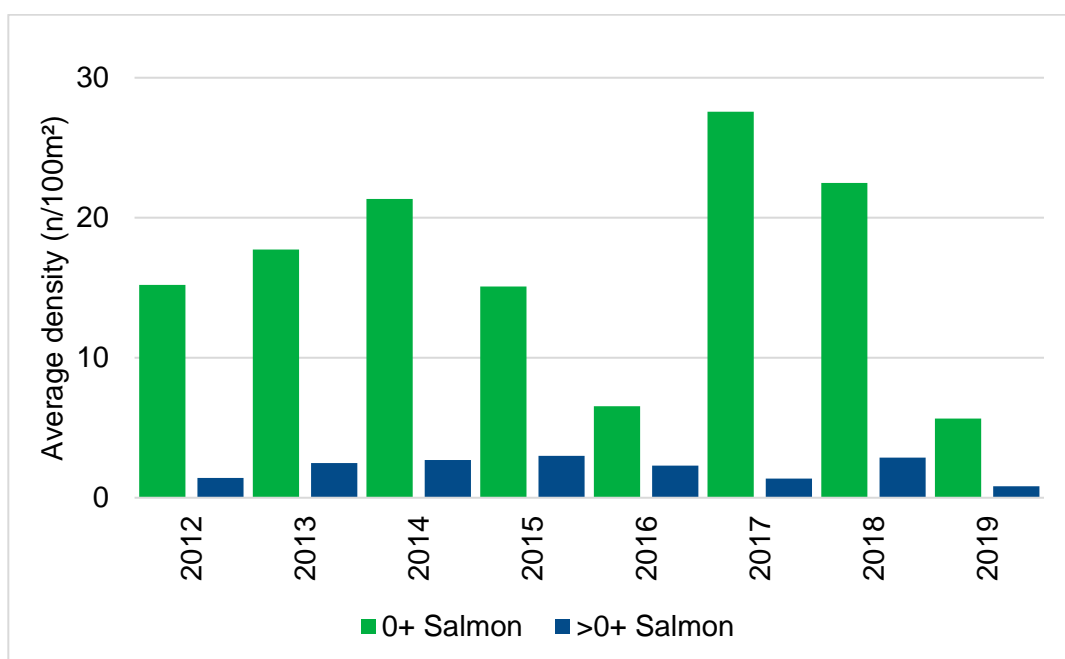


Figure 20 Average juvenile salmon densities recorded from the Upper River Severn catchment between 2012 and 2019. Data provided by NRW.

3.5.3 River Wye and Usk juvenile salmon survey data

The regulation of the Severn estuary net and fixed engine fisheries must take account of the conservation status of salmon in the neighbouring Wye and Usk SACs that are known to be exploited by these estuary fisheries. Results from the relevant Wye and Usk juvenile salmon surveys are briefly described here. Average juvenile salmon densities from the Wye and Usk surveys are presented in **Figures 21 and 22** respectively.

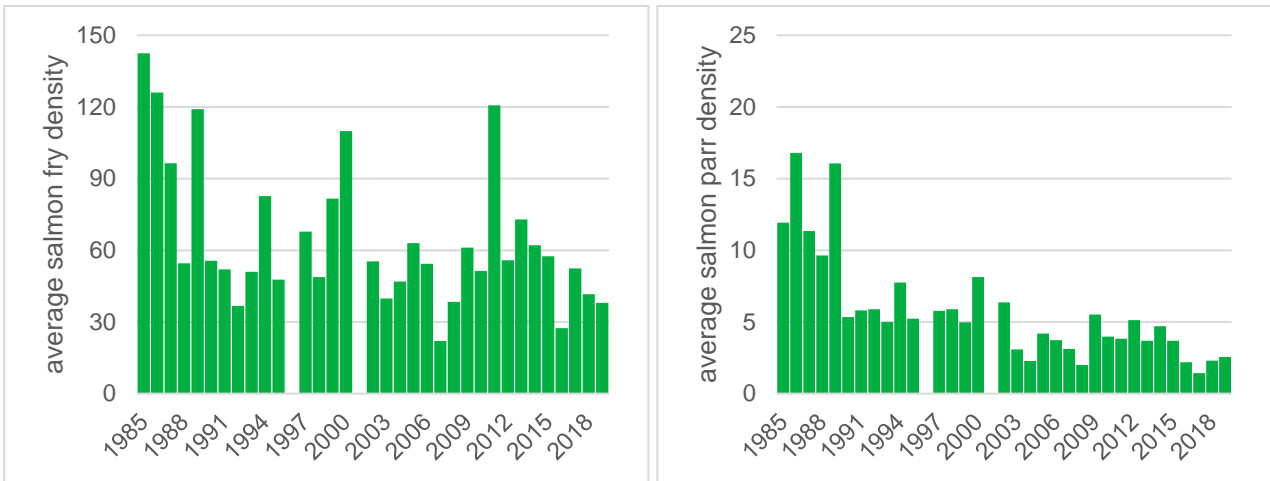


Figure 21 Average juvenile salmon densities recorded from the Wye catchment from 1985 to 2019. No surveys undertaken in 1996 and 2001 (Note differing vertical scales). Data provided by NRW.

Average salmon fry densities for the River Wye catchment have tended to be relatively high and regularly exceeded 40 fry per one hundred square metres of stream. However, the abundance of fry in 2016 are among the lowest recorded salmon fry abundances since 1985. Average salmon parr abundance throughout the River Wye has generally declined from more than 10 parr per one hundred square metres in the late 1980's to less than 5 parr per one hundred square metres in the last twenty years. The most recent average densities of salmon parr recorded across the River Wye catchment are among the lowest in the time series.

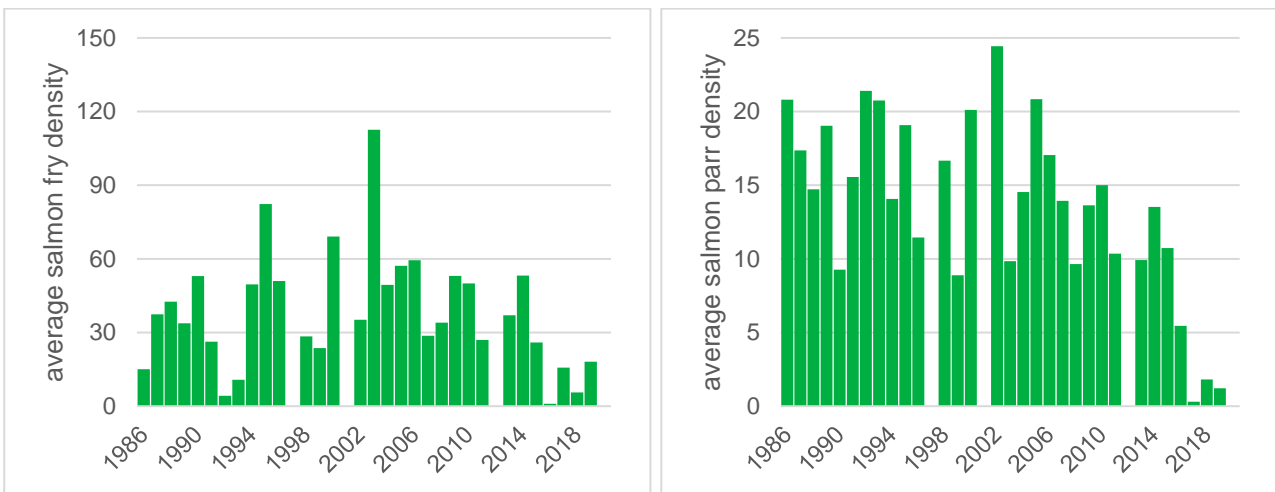


Figure 22 Average juvenile salmon densities recorded from the Usk catchment from 1985 to 2019. No surveys undertaken in 1997, 2001 and 2012. (Note differing vertical scales). Data provided by NRW.

The average abundance of salmon fry in the Usk surveys is generally low, but has been quite variable over short periods. Prior to 2016 salmon parr abundance was regularly in excess of 10 parr per one hundred square metres. By marked contrast, the average parr abundance since 2016 has been less than 2 parr per one hundred square metres, raising significant concern for future adult returns from all these weak year classes.

Overall, the relatively low abundances of fry and especially of parr on all three rivers in the most recent surveys gives significant cause for concern for likely future adult returns.

4 Status of Sea Trout Stocks

4.1 Rod and Net catches

In the **Salmon and migratory statistics for England and Wales, 1951 to 1990**, Russell *et al* (1995) quote, in relation to the river Severn that, “Sea trout are rarely caught in this river, and no attempt has been made to collate these sporadic occurrences.”

The Severn is not and has never been considered to be a principal sea trout river owing to the low and infrequent catches of this species. Catches of sea trout by the estuary net and fixed engine fisheries are rare and, typically, those sea trout declared by anglers are caught as a by-catch by those who are targeting salmon or the more common freshwater resident trout.

Sea trout are a designated interest feature of the Severn Estuary Ramsar Site and also feature as part of the wider fish assemblage of the Severn Estuary SAC. However, as there is no current formal assessment for these EMS (European Marine Sites), the status of the sea trout stock is unknown.

Declared net and rod catches of sea trout for 2010 to 2019 are presented in **Figure 23** below. The total declared sea trout net catch in the Severn estuary over the ten year period was 2, whereas the rod catch in the river ranged from 3 to 69 per year. Notably, declared sea trout rod catches on the nearby Rivers Wye and Usk are also low, averaging 44 and 96 sea trout per year respectively over the same time period. C&R rates of sea trout as reported by anglers on the Severn typically exceed 80%. The average weight of individual sea trout caught is around 2kg (4 to 5lbs).

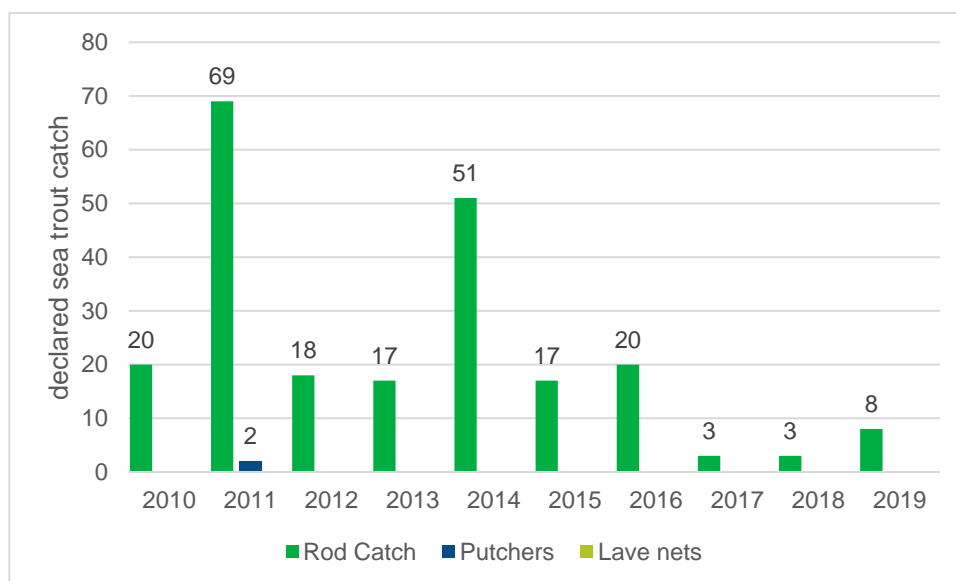


Figure 23 Declared rod and net catch of sea trout for the Severn catchment between 2010 and 2019.

4.2 Juvenile trout survey data

The juvenile trout survey provides a valuable description of the distribution and abundance of juvenile trout in the catchment over recent years, including how that distribution and abundance has changed over time. The NFCS grades for trout from the most recent 2019 survey of the Upper Severn are presented in **Figure 24**, below. With the exception of two sites that recorded grade B densities for trout parr, the survey was dominated by low densities and absences of both fry and parr.

Table 4 NFCS grades in relation to densities (no/100m²) of juvenile trout

Grade	Trout	
	Fry (0+)	Parr (>0+)
A	>38	>21
B	17-37	12-20
C	8-16	5-11
D	3-7	2-4
E	<3	<2
F	0	0

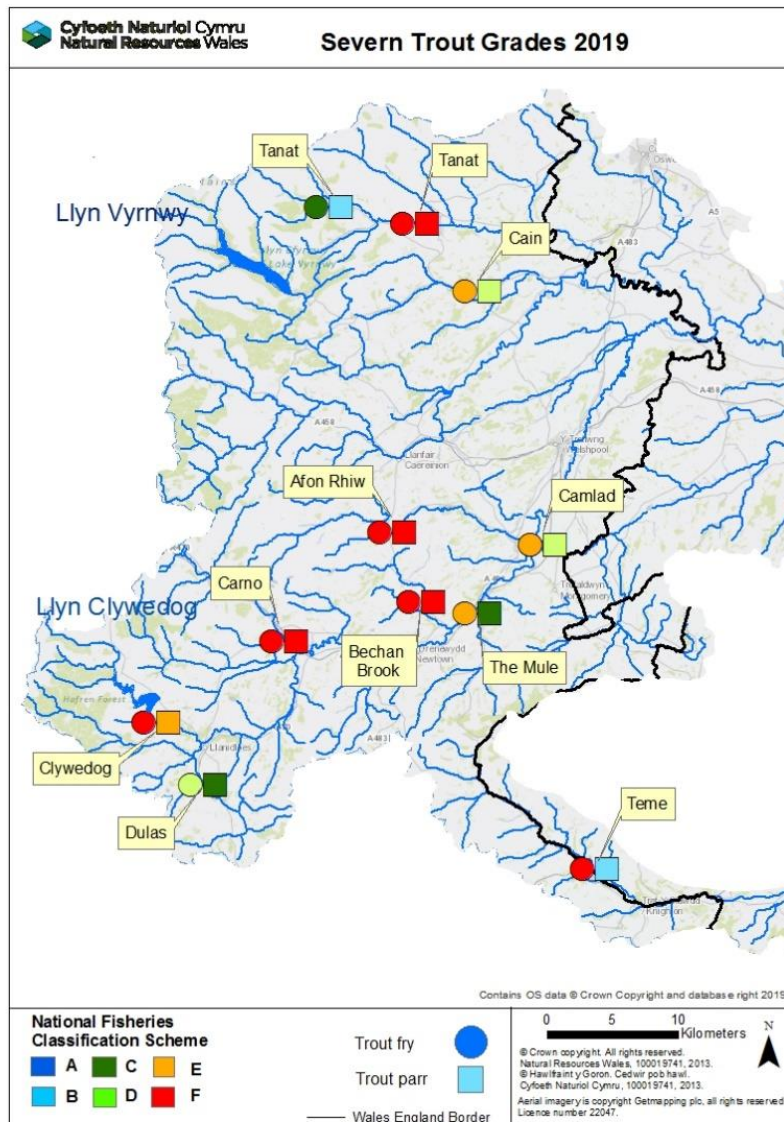


Figure 24 Upper Severn, Vyrnwy and Upper Teme catchment juvenile trout classification grades in 2019. Data provided by NRW

Average trout fry and parr densities from 2012 to 2019 from upper Severn surveys are presented in **Figure 25** below.

Average trout fry (0+) densities at upper Severn sites tend to be low, ranging from one to four fry per one hundred square metres of stream.

Average trout parr (>0+) densities have also been relatively low across the upper Severn catchment in these surveys, rarely exceeding three parr per one hundred square metres of stream.

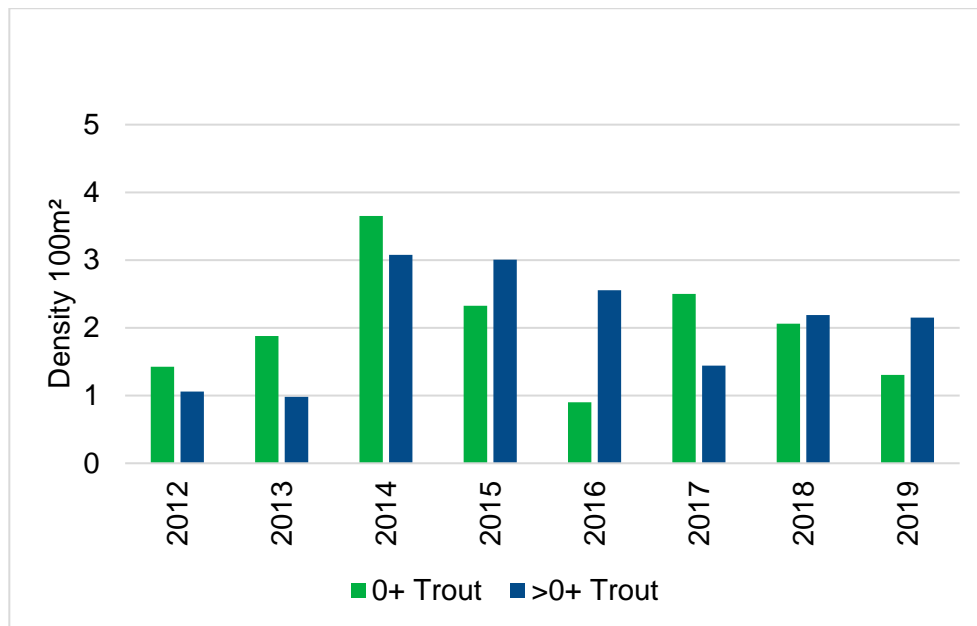


Figure 25 Average juvenile trout densities recorded from the Upper River Severn catchment between 2010 and 2019. Data provided by NRW

Adult sea trout are rarely encountered in the estuary and freshwater fisheries, and are essentially taken as a bycatch. Juvenile trout numbers are especially low in upper Severn surveys and again support the view that sea trout numbers within the Severn are low and insignificant in fishery terms. Such a low stock is unlikely to be able to sustain any targeted exploitation.

5 Rod and Net Fisheries management options

The review of salmon stock status set out above demonstrates that the River Severn salmon stock is currently below its Conservation Limit and therefore cannot provide a harvestable surplus of salmon. This is based upon the following evidence:-

- The Severn salmon stock is currently assessed to be “Probably at Risk” and has failed to achieve the MO which requires the stock to exceed the CL in 4 out of the last 5 years. This stock is predicted to remain “Probably at Risk” within the next 5 years;
- The abundance of juvenile salmon in recent surveys within the spawning tributaries of the Severn catchment has declined;
- There has been a marked decline in adult returns recorded by the River Tanat fish counter in 2017 and 2018, with very low but incomplete data for 2019;
- Both the Wye and Usk SAC salmon stocks are currently assessed to be “Probably at Risk” and are expected to remain so in 5 years’ time. Recent poor juvenile survey results have also been recorded from both rivers.

Overall, this combined weight of evidence provides a strong justification of the need for longer term fishery management measures that will allow the Severn salmon stock to recover to a level that will provide a harvestable surplus for both rod and net fisheries in the future. It is also necessary to ensure that the level of salmon spawning is increased as quickly as possible to ensure that future catchment smolt output can be maximised to enable salmon stock recovery.

Appropriate measures should also be considered for sea trout fishing, to ensure that the exploitation of the limited sea trout stock does not increase, and in order to minimise the possible bycatch of salmon and also minimising the possible risk of mis-identification of small salmon as sea trout.

Whilst there is a need to reduce fisheries exploitation, it is fully recognised that the Severn estuary net fisheries and Severn rod fishery are not solely responsible for the decline observed in salmon stocks. There are a number of initiatives being undertaken by the Environment Agency and a range of partner organisations that are seeking to improve access and in-river habitat within the River Severn catchment to maximise salmon productivity. For example, the ongoing Unlocking the Severn project is improving fish passage at six historic barriers to restore connectivity to 158 miles of river, that will bring benefits for salmon migration on the river Severn. These initiatives are in addition to international investigations into the potential causes of low salmon marine survival. Fishery regulations however, remain necessary to ensure that as many salmon as possible survive the fisheries to spawn.

Given the imperative to reduce exploitation on the relevant salmon stocks, and to not increase exploitation of sea trout stocks, the “Do Nothing” option of allowing unregulated net, fixed engine and rod fishing, is immediately discounted and not examined in detail in the subsequent options appraisal. Similarly, shortening the available fishing season for rods and nets is not considered in detail as this would only deliver very limited savings against the substantial current shortfall in spawning stocks. The total closure of the rod fishery is also not considered in detail, as options to minimise the impact of angling are available, while allowing the recreational and economic benefits of angling to continue.

In considering potential fishing method regulations, we have focussed on specific regulatory and voluntary measures that have already been applied on other rivers or jurisdictions, as examples of good practice of C&R angling. For example, byelaws

requiring the use of barbless hooks are in place in Ireland and Wales. Hook size limits are also applied in byelaws in Wales.

Table 5 Severn estuary net fishery management options

Option	Advantages	Disadvantages
<p>OPTION 1</p> <p>Continuation of lave and draft net fisheries through implementation of:-</p> <ol style="list-style-type: none"> 1) a reducing lave net NLO from 22 to 15 licences 2) and a reducing draft net NLO from 1 to 0 licences 3) catch limits applied to both net fisheries to limit salmon exploitation, based on annual Habs Regs assessments. <p>Continuation of the putcher fishery using catch limits to limit salmon exploitation, based on annual Habs Regs assessments.</p>	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) No advantage over current management scenario. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Maintains the most recent approach to management of the Severn estuary fisheries through a combination of reducing NLOs and the application of Total Allowable Catch (TAC) to limit fishery salmon exploitation. 2) Maintains the existing socio-economic value of all Severn estuary net fisheries. 3) Maintains the cultural status of the lave net and putcher rank fisheries. 	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) Adult salmon stocks on all three contributing rivers (Severn, Wye and Usk) have no harvestable surplus. Even low level exploitation through TAC will at best delay, or at worst prevent recovery of salmon stock. 2) Continued net fishery exploitation impacts the Wye and Usk SACs, preventing their recovery to favourable conservation status. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Patcher fishery has no option to C&R salmon as all captured fish cannot be returned. Therefore, continuation of this fishery, even with a catch limit, would be unsustainable. 2) Continuation of the draft net fishery in the short term would not be consistent with the approach taken on all other draft net fisheries in England that have a high proportion of salmon within their historic catch. 3) No opportunity for potential diversification of the existing fishery to catch other fish species.

Option	Advantages	Disadvantages
<p>OPTION 2</p> <p>Lave net limitation order (NLO) of 22 licences with mandatory 100% C&R byelaw.</p> <p>Byelaw prohibiting the draft net fishery for 10 years.</p> <p>Byelaw prohibiting the putcher fishery for 10 years.</p>	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) Salmon stock protection implemented quickly to maximise the numbers of returning adult salmon. <p>For fishery:-</p> <ol style="list-style-type: none"> 1) Fulfils the Environment Agency obligation with respect to the designated status of salmon within the River Wye and Usk SACs to ensure that these stocks are not impacted by these fisheries. 2) Existing lave net licences retained in the short term subject to mandatory 100% C&R to reduce the impact of the fishery upon salmon. 3) 100% C&R requirement for lave net fishery is unambiguous. 4) Continuation of the lave net fishery recognises the recreational nature of the fishery and is consistent with the approach taken for rod and line fisheries on all contributing river stocks. 5) No longer a need for a Draft Net NLO whilst byelaw prohibiting the activity is in place. 	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) C&R fishing by lave nets may continue to potentially damage fish caught in nets without changes to net mesh. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) It is no longer reducing the fishing effort and the number of lave net licences to 15 as in the previous NLO. However, this risk may be mitigated through implementation of 100% C&R. 2) Loss of the socio-economic value of the draft net and putcher rank fisheries. 3) Loss of the putcher rank as a heritage fishery.

Option	Advantages	Disadvantages
<p>OPTION 3</p> <p>Prohibit all Severn estuary migratory salmonid net fisheries managed by the Environment Agency through the implementation of a Severn estuary net fishery prohibition byelaw</p>	<p>For salmon stock:-</p> <p>1) Salmon stock protection implemented quickly to maximise the numbers of returning salmon.</p> <p>For Fishery:-</p> <p>1) Fulfils the Environment Agency obligation with respect to the designated status of salmon within the River Wye and Usk SACs to ensure that these stocks are not impacted by these fisheries.</p> <p>2) Recognises that the putcher rank fishery cannot release salmon alive once captured.</p> <p>3) Draft net fishery prohibited in line with the approach taken on all other draft net fisheries in England that have a high proportion of salmon within their historic catch.</p>	<p>For salmon stock:-</p> <p>1) No disadvantage</p> <p>For Fishery:-</p> <p>1) Closes the lave net fishery and removes its heritage status.</p> <p>2) Closes the putcher fishery removing its heritage status.</p> <p>3) Not consistent with the approach taken for low impact net fisheries in other estuaries in England.</p>

Table 6 River Severn rod fishery management options

Option	Advantages	Disadvantages
<p>OPTION 1</p> <p>Seek voluntary improvement in salmon rod fishery C&R to achieve a >90% level of salmon C&R and seek to implement voluntary angling method restrictions.</p>	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) No advantage over current management scenario <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Angling groups take ownership of the need to protect salmon stocks, co-ordinating the implementation of increased C&R measures and adopting the use of good C&R angling practices. 2) Follows the approach adopted for other rod fisheries in England in 2018 which were predicted to have a “Probably at Risk” status. 	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) Severn salmon stock has no harvestable surplus. Even low level exploitation through voluntary C&R will at best delay, or at worst prevent recovery of salmon stock. 2) The majority of salmon that are killed, are taken by anglers who only retain one salmon per season. It is easy for the individual angler to think that only taking one salmon will not affect the stock, but the cumulative impact of more than one angler doing so creates an increasing level of impact. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Previous attempts in 2012 to increase the voluntary level of C&R to >90% within the Severn salmon rod fishery have failed to achieve the desired level of C&R. Severn rod fishery records one of the lowest voluntary C&R rates in E&W. 2) Voluntary requirement to release fish may not be acceptable to all anglers or riparian interests throughout the Severn catchment leading to inconsistent application of required measures in a timely manner. 3) Risk of false reporting by anglers on declared catch (already an issue) which may falsely indicate stocks are healthier than they are. 4) Difficult to enforce and monitor compliance. 5) NRW are likely to seek to implement mandatory rod fishing measures in the upper Severn catchment which will be inconsistent with a voluntary approach in the lower catchment.

Option	Advantages	Disadvantages
<p>OPTION 2</p> <p>Byelaw requiring Mandatory C&R of all salmon caught with voluntary method restrictions</p>	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) Salmon stock protection implemented quickly to increase the numbers of returning adult salmon <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Recognises that salmon stocks are in decline and are currently at unsustainable levels with a need to restore stocks to a favourable status as soon as possible. 2) Provides a clear and unambiguous requirement for all rod anglers and riparian interests to release all salmon captured. 3) Avoids the risk of false reporting by rod anglers on declared catch which may falsely indicate stocks are healthier than they are. 	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) No disadvantage over current management scenario 2) C&R survival may be severely compromised if necessary changes to angling methods are not implemented quickly and consistently. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Voluntary implementation of rod and line angling measures are unlikely to be consistently applied in a timely manner. 2) The need for 100% mandatory C&R does not follow the approach adopted for other rod fisheries in England in 2018 which were predicted to have a “Probably at Risk” status. 3) Implementation of mandatory C&R and voluntary changes to angling methods may reduce future participation in salmon fishing.

Option	Advantages	Disadvantages
<p>OPTION 3</p> <p>Byelaw requiring Mandatory C&R of all salmon caught plus Method restrictions by byelaw –</p> <p>Prohibition of bait fishing, all flies and lures to be fitted with barbless or de-barbed hooks, barbless single hooks only on lures up to maximum 13mm gape, up to 3 single barbless hooks permitted on wobbler or jointed lures, barbless double or treble hooks permitted on flies up to maximum hook gape of 7mm</p>	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) Salmon stock protection implemented quickly to maximise the numbers of returning adult salmon 2) Mortality associated with C&R is minimised <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Recognises that salmon stocks are in decline and are currently at unsustainable levels with a need to restore stocks to a favourable status as soon as possible. 2) Provides a clear and unambiguous requirement for all rod anglers and riparian interests to release all salmon captured and to utilise angling methods that seek to maximise salmon survival post C&R. 3) Consistent with rod fishery regulation recently introduced by NRW in Wales and on other cross border rivers. 4) Avoids the risk of mis-reporting of declared catch (already an issue) which may indicate stocks are healthier than they are. 5) Likely to maximise compliance and enforcement of the measures necessary to protect salmon. 	<p>For salmon stock:-</p> <ol style="list-style-type: none"> 1) No disadvantage over current management scenario <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Prohibition of bait fishing for salmon may impact on those anglers who favour this method, although other bait fishing opportunities remain for coarse fish species. 2) May result in a short term reduction in the number of salmon anglers, as observed on other mandatory C&R rivers. 3) Does not follow the approach adopted for other rod fisheries in England in 2018 which were predicted to have a “Probably at Risk” status.

Table 7 Severn sea trout fishery management options

Option	Advantages	Disadvantages
<p>OPTION 1</p> <p>Byelaw to set an upper size limit for rods and nets for sea trout >60cm (total length) must be returned.</p>	<p>For sea trout/salmon stock:-</p> <ol style="list-style-type: none"> 1) Prevents increased exploitation of larger sea trout. 2) Provides immediate protection for larger sea trout in rod and net fisheries. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) This would be consistent with Welsh byelaws. 	<p>For sea trout/salmon stock:-</p> <ol style="list-style-type: none"> 1) Still a risk of damage and subsequent mortality of adult salmon associated with the rod fishing methods. 2) Small risk of small salmon <60cm (<5% of declared rod catches) being mis-identified as sea trout and killed. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) May result in a short term reduction in the number of salmon anglers, as observed on other mandatory C&R rivers.
<p>OPTION 2</p> <p>Byelaws requiring 100% C&R of rod caught sea trout & 100% C&R by lave nets</p>	<p>For sea trout/salmon stock:-</p> <ol style="list-style-type: none"> 1) Prevents increased exploitation of sea trout. 2) Provides immediate protection for all sea trout in rod and net fisheries. 3) No risk of salmon being mis-identified as sea trout and killed. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Unambiguous regulation. 	<p>For sea trout/salmon stock:-</p> <ol style="list-style-type: none"> 1) No disadvantage over current management scenario. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) May result in a short term reduction in the number of salmon anglers, as observed on other mandatory C&R rivers.
<p>OPTION 3</p> <p>Option 2 plus byelaw defining rod fishing method restrictions as per proposed salmon option 3 (Table 6, p47)</p>	<p>For sea trout/salmon stock:-</p> <ol style="list-style-type: none"> 1) Provides immediate maximum protection for all sea trout in rod and net fisheries. 2) No risk of salmon being mis-identified as sea trout and killed. 3) C&R mortality minimised for both species. <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) Unambiguous regulation, consistent with the approach on the adjacent river Wye which broadly supports a similar fishery. 	<p>For sea trout/salmon stock:-</p> <ol style="list-style-type: none"> 1) No disadvantage over current management scenario <p>For Fishery:-</p> <ol style="list-style-type: none"> 1) May result in a short term reduction in the number of salmon anglers, as observed on other mandatory C&R rivers.

5.1 Preferred fishery management options

Given the recent 40 to 50% spawning deficit on the Severn, as well as the need to protect the Wye and Usk SAC salmon stocks that are exploited in the Severn estuary fisheries, we have considered the range of fishery management options described in the tables above.

Our preferred and most protective package of measures available at this time for both the net and rod fisheries is as follows:

5.1.1 Net Limitation Orders and Net/fixed engine Byelaws

Proposed Measure	Objectives & Reasoning
<p>Net Limitation Order (NLO) – Lave Nets</p> <p>Capped to 22 licences available each season.</p>	<p>A renewed NLO is important in order to regulate the number of net fishing licences issued for fishing in the public net fisheries.</p> <p>This will allow current licence holders to be eligible for licences again in the future, should all three relevant salmon stocks improve to exceed their respective conservation limits.</p> <p>As licence holders leave the fishery (do not renew licence annually), the number of available licences shall not exceed the current level (22) while allowing new entrants to apply for a licence to maintain a heritage fishery.</p> <p>This NLO will protect the current cultural fishery interest and protect against any increased level of fishing effort in terms of number of available licences, but specific savings in terms of number of salmon that are not killed will be delivered through the proposed byelaws.</p>
<p>Byelaw – Lave Net</p> <p>Catch release of all salmon and sea trout caught by the Severn estuary lave nets</p>	<p>Requires the immediate release, alive, of all lave net caught salmon and sea trout in the Severn estuary.</p> <p>Salmon stock levels of the rivers that contribute to the Severn estuary mixed stock fishery are below a level that can provide a harvestable surplus. Continuing to kill fish whilst stocks are depleted presents an unacceptable risk. The lave net has heritage value to the area and should be allowed to be practised for cultural and educational benefit.</p> <p>The “Lave Net” interpretation in the byelaw shall allow an option for a sheet of netting with a smaller knotless mesh size to be used. This provides an option to reduce the risk of potential damage and increase survival chances of fish caught and released.</p>
<p>Byelaw – Draft Net</p> <p>Prohibit the fishing with a draft net</p>	<p>Salmon stock levels of the rivers that contribute to the Severn estuary mixed stock fishery are below a level that can provide a harvestable surplus. Continuing to kill fish whilst stocks are depleted presents an unacceptable risk.</p> <p>We consider it is not possible to fish a draft net for C&R as a safe option for salmon welfare.</p> <p>The draft net is not a unique heritage or specific to the region to justify retention.</p> <p>Will remove the need for reducing NLO, will be reviewed again in the future, should all three relevant salmon stocks improve to exceed their respective conservation limits.</p>

Cont'd.

Proposed Measure	Objectives & Reasoning
Byelaw – Fixed Engines Prohibit the fishing of the fixed engines (putchers, putts and associated ranks)	<p>Salmon stock levels of the rivers that contribute to the Severn Estuary mixed stock fishery are below a level that can provide a harvestable surplus. Continuing to kill fish whilst stocks are depleted presents an unacceptable risk.</p> <p>It is not possible to fish these fixed engines so that fish remain alive to be returned unharmed.</p>

These proposed byelaws and NLO will be time-limited to a period of ten years with a commitment to review after five years.

5.1.2 Byelaws – Severn Rod Fisheries

Proposed Measure	Objectives & Reasoning
Byelaw – Rod & Line Mandatory C&R of all rod caught salmon and sea trout	<p>Requires the immediate release, alive, with least possible injury of all rod caught salmon on the main river Severn and all tributaries that flow into it.</p> <p>We consider salmon stock levels in the Severn catchment to be below a sustainable exploitation level. Continuing to kill fish whilst stocks are depleted presents an unacceptable risk for the recovery of the stock.</p> <p>In combination with the bait, barbless and single hook byelaws, this allows as many salmon to escape the rod fishery as possible to successfully spawn.</p> <p>Will be consistent with NRW & EA byelaws on all cross border rivers and therefore avoid confusion.</p>
Byelaw – Rod & Line No bait fishing for salmon with worm, prawn and shrimp.	<p>Risk of salmon mortality caught on bait is comparatively high – can be in the excess of 50%.</p> <p>In combination with the mandatory C&R byelaw and barbless and single hook byelaws, this allows as many salmon to escape the rod fishery as possible to successfully spawn.</p> <p>Will be consistent with NRW Wye byelaws.</p>
Byelaw – Rod & Line Barbless or de-barbed hooks only	<p>Maximise post catch and release survival through good C&R practice.</p> <p>Using barbless or de-barbed hooks markedly reduces handling time during unhooking and potential exposure to air during the release phase.</p> <p>In combination with the mandatory C&R byelaw and bait and single hook byelaws, this allows as many salmon to escape the rod fishery as possible to successfully spawn.</p> <p>Will be consistent with NRW approach for Welsh rivers.</p>

Cont'd.

Proposed Measure	Objectives & Reasoning
<p>Byelaw – Rod & Line</p> <p>Artificial lures and spinners to be fitted with single hooks, no more than 13mm gape</p>	<p>Maximise post C&R survival.</p> <p>Mortality of certain types of lures fitted with treble hooks is unacceptably high.</p> <p>In combination with the mandatory C&R byelaw and baiting and barbless hook byelaws, this allows as many salmon to escape the rod fishery as possible to successfully spawn.</p> <p>Will be consistent with the new NRW All Wales and Cross Border salmon protection byelaws that apply to the River Wye, Usk and other rivers in Wales.</p>
<p>Byelaw – Rod & Line</p> <p>Wobblers, plugs or artificial imitation baits may use a maximum of 3 single barbless or de-barbed hooks with each single hook, no more than 13mm gape.</p>	<p>Maximise post C&R survival.</p> <p>Reduces potential physical injury and reduces unhooking times, improves survival of released fish.</p> <p>In combination with the mandatory C&R byelaw and baiting and barbless hook byelaws, this allows as many salmon to escape the rod fishery as possible to successfully spawn.</p> <p>Will be consistent with NRW byelaws.</p>
<p>Byelaw – Rod & Line</p> <p>Artificial flies may be used with either a single barbless hook with 13mm gape or a single barbless or de-barbed double or treble hook with a maximum hook gape of 7mm</p>	<p>Maximise post C&R survival.</p> <p>Reduces potential physical injury and reduces unhooking times, improves survival of released fish. Generally the use of fly has a higher survival than other fishing methods, this is taken in to consideration and supports the use of small double and treble hooks.</p> <p>In combination with the mandatory C&R byelaw and baiting and barbless hook byelaws, this allows as many salmon to escape the rod fishery as possible to successfully spawn.</p> <p>Will be consistent with NRW approach for Welsh rivers.</p>

This combination of regulations would deliver the greatest potential savings achievable through the reduction of exploitation, but would not be sufficient to compensate for the prevailing substantial deficit in spawning stocks/egg deposition. Further directed action towards other limiting factors in freshwater will be needed to boost natural juvenile production and subsequent adult spawning stocks.

5.2 Socio-economic impacts of preferred management option

Our primary objective for the management of salmon stocks is to maintain the productive capacity of individual stocks. When new regulations are considered necessary to maintain that productive capacity, then socio-economic factors may be taken into account to influence the nature and balance of controls affecting different stakeholder groups and the rate of stock recovery that is planned.

Consideration is given to:

- whether a proposed measure will have an unreasonable effect on someone's livelihood (e.g. net fishing) or the value of their property (e.g. fishing rights); this may mean that it is necessary to reduce the impact of a conservation measure, for example by planning the recovery of the stock over a longer period;
- whether one group of stakeholders will be unreasonably affected relative to another; where reductions in exploitation are required, the effects on netters and anglers should be equitable;
- whether the controls will affect the viability of commercial and recreational fisheries; for example, C&R controls will generally have a greater economic effect on commercial than recreational fisheries;
- the heritage value of the fishery; where fishing methods are unique to a very small number of locations, consideration is given to retaining a residual fishery and/or permitting a low level of catch.

5.2.1 Minimum Nett Economic Value of the Severn salmon fisheries

We use the following method to calculate the Nett Economic Value of a salmon fishery which is defined by summing the following components:

- Value to rod fishery owner community (calculated by estimating the market value of fishing rights).
- Value to salmon angling community (calculated by estimating the consumers' [anglers'] surplus).
- Value to salmon netting community (calculated by estimating Nett profits from catch sales).

5.2.1.1 Market value of rod fishing rights

This is defined as the present value of the capitalised future nett benefits to the owners of the rod fishing rights. The market value of a salmon fishery is a function of both the average annual rod catch and the value of each salmon caught within the fishery.

In order to eliminate as much yearly variation as possible from the rod catch data, it would be appropriate to use a five-year average of recent rod catches. To compensate for the 30 to 40% of anglers that still fail to make a catch return, the average annual declared catch has been multiplied by a correction factor of 1.1 (Small, 1991) to obtain an estimate of the total catch. This correction factor reflects the fact that 60% of anglers report 90% of the catch.

Radford *et al.* (1991) performed a national survey in 1988 to establish the mean value of a salmon in various regions in England and Wales. Taking into account inflation within the

intervening period, this study valued rod-caught salmon in the Severn in 2001 to be worth £1,000 per fish caught. This is a particularly low value compared to other regions, and may be a reflection of the sale valuations being derived from a small number of fisheries. Instead of using this apparently low valuation, we will revert to the national average valuation of £9,000 per salmon caught, based on 2001 values and adjusted for inflation to a present day value of £15,000 rounded to the nearest £100 (£14,997 based on Bank of England inflation calculator).

Table 8 presents the market value of the River Severn rod fishery, based upon the average annual rod catch and the estimated value of a salmon.

5.2.1.2 Anglers' Consumers Surplus.

This term describes an economic valuation of the fishery to anglers. It is the difference between what anglers would be willing to pay for their fishing and what they actually pay. The total for a given river represents the sum of the surpluses for all of the individual anglers who fish the river.

Only one study has calculated the capitalised anglers' consumers' surplus of salmon anglers (Radford, 1984). Radford (1984) compared the market value of the fishing rights and the capitalised anglers' surplus for four salmon rivers in England and Wales. The ratios varied widely so to ensure consistency on a national basis, the lowest ratio (1:1) has been used as a conservative estimate of the capitalised anglers' consumers' surplus.

For the purposes of this report, the capitalised anglers' consumers' surplus is assumed to be to the same as the estimated market value of the fishing rights (**Table 8**).

Table 8 Market value of Severn rod fishery

Mean declared Annual rod catch including released fish 2014-2018	Mean total Annual rod catch	Mean Regional value per salmon	Market (capital) value to rod fishery	Angler's consumers Surplus
305	332	£15,000	£4.98million	£4.98million

5.2.1.3 Net fishery Nett Profit

To assess the profits to netters, it is necessary to subtract their estimated costs in operating the fishery (e.g. fuel, fish boxes, maintenance of fishing gear, licence). Radford *et al.* (1991) assessed these costs for 1988 to be on average about 40% of the gross revenue across England & Wales. Given that catches and the price of wild salmon has dropped since 1988, and costs (especially licence duties) have risen, a review by economists from MAFF (Ministry of Agriculture, Fisheries and Food) and the Environment Agency indicates that this proportion may now be 75% nationally.

Table 9 Nett profit for net fishery catch (conversion 1kg = 2.205lb)

Fishery	Average total catch per year (n) 2014-2018	Average total weight per year (kg)	Estimated first sale value (£) @£15/kg
Lave Net	31	149.4	2,241
Draft Net	4	19.0	285
Putcher	79	390.4	5,856
total			8,382

The nett profit based on recent catches is therefore 25% of £8,382 or about £2,095 per year. For comparison with the capitalised values for the rod fisheries, these annual net fishery profits also need to be capitalised, following MAFF advice and using the discount rate (8% per annum) and time horizon (25 years). Nett profit is multiplied by 10, providing an estimated value of £20,950.

These profits to netters may be a maximum estimate of the nett economic value of the net fishery as true costs are difficult to estimate and they assume that there is no opportunity cost (i.e. return from alternative use) for labour and equipment. This may not be true as many netters are likely to be able to generate income from alternative livelihoods in other fisheries or occupations. On the other hand, there will be those netters for whom salmon fishing is more than a commercial activity and they, like the anglers, may derive a consumers' surplus. Such netters will value their fishing at more than the financial profit they derive from selling their catch but this cannot be readily accounted for here.

Calculation of the Nett Economic Value

The minimum nett economic value for the River Severn salmon fisheries can be calculated by summing the components described above, as shown in **Table 10**.

Table 10 Nett economic value of the River Severn salmon fisheries

Fishery component	Value (£K)
Fishery owners	4,980
Salmon anglers	4,980
Netters	21
Minimum Nett Economic Value	9,981

5.3 Effect of proposed restrictions on net, fixed engine and rod fishing activity

Given the substantial deficits in the current spawning stocks and the low observed abundance of juvenile salmon in recent surveys of the three exploited rivers, the continuation of the TAC method for the estuary fisheries, and the lack of catch restrictions (post 16 June) for the Severn rod and line fisheries, are no longer compatible with the objectives of recovering each exploited river stock so that it exceeds its respective CL in at least 4 years out of 5, and also of maintaining the Wye and Usk SAC stocks in favourable condition.

The proposed regulations are considered to be proportionate to the need to protect the productive capacity of the relevant stocks and the restrictions apply to both net and rod fisheries. Those fishing activities that pose the greatest impact on the survival of salmon at this time will be prohibited by byelaws. Specifically, the putcher and draft net fisheries will be prohibited as these cannot realistically operate on a C&R basis, as a means of keeping the fishing activity and participation going, while minimising their impact on the salmon caught. Lave net fishing will be permitted on a strict C&R basis as this method is expected to allow a high survival of salmon following release. The prohibition of bait fishing by rod and line and the imposition of rod and line method restrictions are deemed necessary to minimise the impact of this fishery on the survival of released salmon, thereby allowing more salmon to escape the fisheries to spawn. The estimated effects of national byelaws on rod and net fisheries were examined in 2018 (Table A from Amec Foster Wheeler 2018 summary report), and are reproduced in Appendix 4 for reference. Similar effects may become evident in response to these Severn regulations, albeit on a smaller scale, as estimated in tables 9, 10, 12 and 13.

The approximate gross valuations of salmon sales from the net fisheries, based on recent catches, are identified in **Table 9** above, as an approximate measure of the monetary impact of the proposed regulations on these fisheries. Compensation may be payable to net fisheries impacted by the byelaws.

The National byelaws introduced by the Environment Agency in December 2018 did not specifically apply new regulations to the Severn rod fisheries, because the Severn salmon stock was classified as “Probably Not At Risk” at that time (based on 2017 stock assessment). However, the effect of a number of potentially restrictive catch options were specifically examined by direct survey of anglers in the accompanying socio-economic assessment for those proposed byelaws. The results of that survey relevant to the Severn is reproduced in **Table 11** below (from Table B from Amec Foster Wheeler 2018 summary report):

Table 11 The reduction in the aggregate number of angler days based on declarations by consultees of which Option would lead to a response of “stop fishing”

District*	Option 1 Mandatory C&R byelaw for At Risk; Prob at Risk and Prob Not at Risk rivers.	Option 2 Mandatory C&R byelaw for At Risk and Prob at Risk rivers; Increase voluntary C&R on Prob Not at Risk rivers.	Option 3 Mandatory C&R byelaw for At Risk rivers; Increase voluntary C&R on Prob at Risk and Prob Not at Risk rivers.	Option 4 Voluntary C&R: As close to 100% as possible on At Risk rivers; >90% for Prob at Risk rivers; Increase above current level for Prob Not at Risk rivers.
Severn*	53%	16%	16%	1%
All	44%	27%	17%	6%

* Districts selected based on EA 2018; Only English anglers included fishing in the English part of the District. Source: Amec Foster Wheeler, 2018.

For the option of applying mandatory C&R to rivers in the “At Risk”, “Probably at Risk” and “Probably Not at Risk” categories (Option 1), an effort reduction of 53% was estimated.

For the option of applying mandatory C&R to rivers in the “At Risk” and “Probably at Risk” categories, with a voluntary increase in C&R sought for rivers in the Probably Not At Risk category (Option 2 of the 2017 consultation) a potential 16% reduction in fishing effort was estimated for the English part of the Severn.

The actual declared fishing effort following the implementation of emergency C&R byelaws on the Severn in 2019 represented 61% of the previous 5-year average annual fishing effort – a reduction in fishing effort of 29%.

Using known recent numbers of licensed anglers and fishing effort (e.g. Figure 11, page 27), along with estimates of fishing trip related and non-trip related expenditure, as detailed in “A Survey of Freshwater Angling in England Phase 1” (EA, 2018), it is possible to calculate the economic impact of the proposed regulations for the rod fishery as detailed in **Tables 12 and 13** below.

Table 12 Estimated reduction in Trip Related Expenditure

Average fishing effort (days) 2014-2018	53% Estimated effort reduction (days)	Trip Related Expenditure (£/day)	Total estimated TRE reduction (£)
3677	1949	£70.30 ¹	£137,016

¹ – 2015 value (£62.00) raised to 2020 value using Bank of England Inflation Calculator

Table 13 Estimated reduction in Non Trip Related Expenditure

Average number of anglers per year 2014-2018	53% estimated angler reduction	Non Trip Related Expenditure (£/angler)	Total estimated NTRE reduction (£)
272	144	£1,181.34 ²	£170,052

² – 2015 value (£1042.00) raised to 2020 value using Bank of England Inflation Calculator

NB – the survey results (estimated effort reduction, TRE & NTRE) are based on responses specific to the English part of the Severn only, while the number of anglers and fishing effort statistics are derived for the whole Severn and cannot readily be separated into

Welsh and English statistics. The total cost estimates given here represent the whole Severn.

Evidence from other rivers where mandatory C&R has been applied in the past indicate a reduction in participation in salmon angling is likely in the short term. However, if fish numbers recover, it is likely that anglers will return, as has been the case on the River Wye following implementation of 100% mandatory C&R byelaws in 2012.

Angling effort expressed as the number of days fished by migratory salmonid rod licence holders on the Severn has fallen by 83% from ~15,000 in 1995 to ~2,600 in 2019. A similar trend is broadly observed in other regions of England and Wales. The overall salmon fishing effort on the Severn is much smaller compared to other regions (Figure 26).

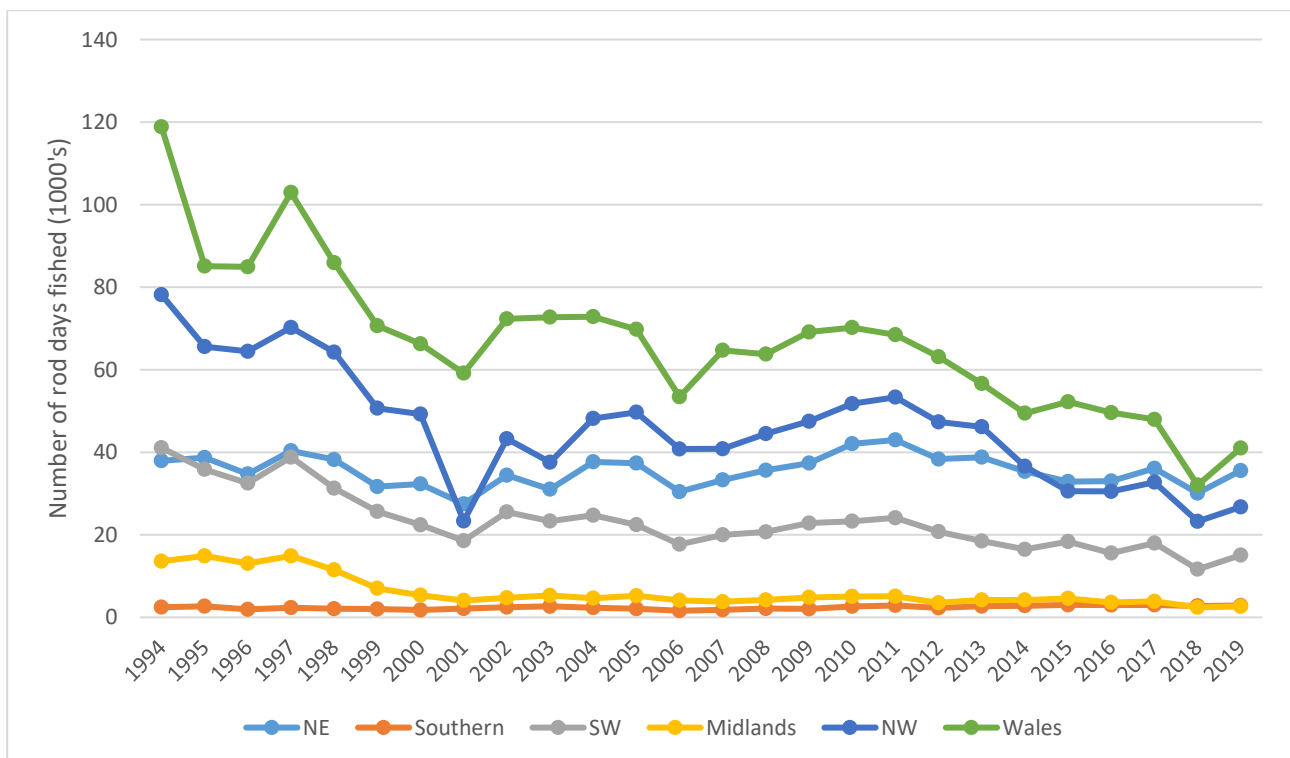


Figure 26 Salmon angling effort expressed as days fished between 1994 and 2019 in England & Wales

Conclusion

The recent stock assessments for the Severn indicate that there is no harvestable surplus of salmon available for the net and rod fisheries to exploit. The shortfall in spawning stock is substantial, with the 2019 stock assessment equating to 51% of the CL. This equates to approximately 875 spawning females in 2019 out of 1720 females required to achieve the CL level. Reductions in juvenile salmon abundance observed in recent surveys further compounds the concern for the future health of the salmon stock.

We consider that the proposed byelaws, provide the correct balance between achieving the necessary protection for the exploited salmon stocks and minimising the impact on net and rod fisheries where possible. We recognise the impact that these proposed Byelaws will have, particularly on the putcher and draft net fisheries that will be prohibited from operating, and also on bait fishing by rod and line which will also be prohibited.

6 References

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7 Glossary

Certificate of Privilege (CoP) – a form of authorisation granted by Government in the 1860s to about 45 fisheries. The certificates define the precise location of each rank and the number of putts (larger baskets) or putchers that may be used within it. See Appendix 2

Conservation Limit (CL) - The minimum spawning stock levels below which stocks should not be allowed to fall. The CL for each river is set at a stock size (defined in terms of eggs deposited) below which further reductions in spawner numbers are likely to result in significant reductions in the number of juvenile fish produced in the next generation.

Draft net - conventional seine nets set to encircle and catch salmon. See Appendix 2

Exploitation - Removal of fish from a stock by fishing.

EU Exit changes to Habitat Regulations - EU exit changes to the Conservation of Habitats and Species Regulations 2017 (as amended). The Secretary of State for the Environment, Food and Rural Affairs and Welsh Ministers have made changes to parts of the 2017 Regulations so that they operate effectively. Most of these changes involved transferring functions from the European Commission to the appropriate authorities in England and Wales. All other processes or terms in the 2017 Regulations remain unchanged and existing guidance is still relevant. The obligations of a competent authority in the 2017 Regulations for the protection of sites or species do not change.

<https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017>

Fishery - The area where it is, or may be, lawful to fish and where the resource is exploitable.

Fixed engine (FE) - The term fixed engine is an ancient one used in the UK as a general descriptor of stationary fishing gears.

Fry - Juvenile salmon or trout less than one year old i.e. from the previous year's spawning.

Grilse - An adult salmon that has spent only one winter feeding at sea before returning to freshwater to spawn (see also one sea-winter salmon).

Harvestable Surplus - means the number of salmon from a stock's annual run that is surplus to escapement needs and can reasonably be retained (killed) or made available for harvest.

Historic installation fisheries (HI) use putchers, which are conical baskets traditionally made from natural materials, but more recently from steel. They are fished in ranks, often containing many hundreds of baskets (see also fixed engine). See Appendix 2

Lave nets - large triangular hand-held nets that are used by fishers to actively intercept and catch individual salmon. See Appendix 2

Management target (MT) - A spawning stock level for managers to aim at in order to meet the management objective. The 'management objective' used for each river in England and Wales is that the stock should be meeting or exceeding its CL in at least four years out of five (i.e. >80% of the time), on average.

Mixed stock fishery (MSF) - A fishery that predominantly exploits mixed river stocks of salmon. The policy in England and Wales is to move to close coastal net fisheries that exploit predominantly mixed stocks where the capacity to manage individual stocks is compromised. Fisheries, including MSFs, operating within estuary limits are assumed to exploit predominantly fish that originated from waters upstream of the fishery; these fisheries are carefully managed to protect the weakest of the exploited stocks, guided by the decision structure and taking into account socio-economic factors and European conservation status where applicable.

Multi Sea-Winter (MSW) salmon - An adult salmon that has spent two or more winters at sea.

Net Limitation Order (NLO) - Mechanism within the Salmon and Freshwater Fisheries Act 1975 whereby the competent authority may apply to limit the number of nets or traps fishing a particular area.

One Sea-Winter (1SW) salmon - An adult salmon that has spent only one winter feeding at sea before returning to freshwater to spawn (see also Grilse).

Parr - Older freshwater stage of salmonids which follows the fry stage.

Precautionary Approach – a principle which requires that more caution is exercised when scientific information is uncertain.

Putcher - conical baskets traditionally made from natural materials, but more recently from steel. They are fished in ranks. See Appendix 2

Run - The number of adult salmon ascending, or smolts descending, a river in a given year. The main smolt run takes place in spring, whereas adult salmon runs may occur throughout spring, summer, autumn or winter.

Special Area of Conservation (SAC) - An area designated under the EU Habitats Directive (92/43/EEC) giving added protection to identified species and habitats. Where salmon is a “qualifying species”, additional protection measures are required specifically for salmon.

Spawning escapement – optimal number of adult spawners that return to spawn in the catchment to support recruitment.

Smolt - A young salmon (or trout) after the parr stage, when it becomes silvery and migrates to the sea for the first time.

Smolt age - The number of winters, after hatching, that a juvenile salmon remains in freshwater prior to emigration as a smolt (this does not, therefore, include the winter in which the egg was laid).

Stock - A management unit comprising one or more salmon populations, which may be used to describe those salmon either originating from or occurring in a particular area. Thus, salmon from separate rivers are referred to as “river stocks”.

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