River Derwent Rod Fishery Byelaw Review 2022 – Technical Case

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Executive summary

Salmon and sea trout exploitation in the Cumbrian River Derwent rod fishery is regulated by local and national byelaws. This includes a time-limited local byelaw which expires in July 2023. There is therefore an imminent need to review the status of stocks and consider appropriate measures to ensure that they are adequately protected into the future. This report outlines the current state of salmon and sea trout stocks in the River Derwent catchment.

In the past ten years particularly, salmon stocks in the Derwent catchment have declined to the lowest levels on record. This decline is consistent with patterns reported throughout much of England and further afield and is likely to be primarily driven by factors within the marine environment. On the Derwent, these declines are reflected in rod fishery catches and, in part, juvenile survey data. Recent rod catches are at all-time lows. Juvenile salmon survey data indicate that whilst there are some encouraging results, densities across the catchment are generally below their historic potential. Given the current low abundance of salmon, habitat within the rivers is likely to be under-utilised. Any increase in numbers of spawning salmon is likely to increase juvenile fish stocks, smolt output and subsequent adult returns.

The Management Objective for salmon stocks is that they should exceed their Conservation Limit in at least four out of the last five years. Derwent salmon stocks have not achieved this, having only exceeded Conservation Limit twice in the last five years. Based on the most recent 10 years of Conservation Limit compliance data, Derwent salmon stocks are classified as ‘At Risk’ of failing to achieve the Management Objective and are declining further. There is less than 5% probability of the stock achieving the Management Objective in five years’ time. This is the most severe, and worst risk categorisation. As a result of this, the River Derwent Special Area of Conservation (SAC), of which Atlantic salmon are a qualifying feature, is considered to be in unfavourable condition.

Whilst an equivalent stock assessment is not available for sea trout populations, a more basic assessment of fishery performance classifies their stock as ‘Probably Not At Risk’. Derwent catchment sea trout catches remain below historic levels but seem more stable than those of salmon. Juvenile trout densities, particularly fry densities, show more positive signs of stability and/or improvement in relation to site potential. Higher levels of voluntary catch and release of sea trout than for salmon are shown within rod catch data. There is a need to ensure sea trout stocks do not deteriorate, but we do not believe their stocks require the same level of action as those of salmon.

On the basis of our review of salmon stocks in the Derwent catchment, there is a clear need to maximise the number of returning adults surviving through to spawning. Every spawning salmon is now crucial, and the Derwent salmon stock has no sustainable harvestable surplus. It is therefore necessary to reduce the numbers of salmon directly killed within the rod fishery to zero, and also to improve the survival of fish that have been caught and released.

On the basis of our review of sea trout stocks, we do not believe there is a current need to reduce their exploitation beyond current levels. We do however propose to ensure management of sea trout stocks aims to prevent possible future decline, and compliments salmon management.

We therefore set out a series of salmon and sea trout management options, including our preferred options. We have sought to retain the socio-economic benefits of the fishery by keeping it open, whilst protecting stocks in line with our decision structure and in accordance with their current state.

With regards to salmon, we intend to introduce new byelaws requiring that all salmon caught in the Derwent rod fishery are returned immediately and with least possible injury. That is to say, we intend to continue to support fishing for salmon, but on a mandatory 100% catch-and-release basis only. We do not intend to introduce the same requirement for sea trout, stocks of which are such that we believe retention of fish can still be managed voluntarily.

We also propose that under new byelaws, angling methods and tackle are regulated to increase the survival of salmon and sea trout that are caught and released. We propose the requirement for the use of barbless or de-barbed hooks only, with restrictions on the size and number of hooks that can be used, dependant on method. We also intend to prohibit the use of natural baits such as worm and shrimp/prawn.

The Environment Agency believe that the proposed measures are balanced, appropriate and proportional to the level of risk that Derwent salmon and sea trout are currently facing. This package of measures will be in place for up to ten years with a mid-term review proposed after five years.

Restrictions on the rod fishery will not, on their own, address declines in salmon abundance. The proposals to reduce exploitation set out here are only one part of the jigsaw, but nonetheless are necessary and proportionate to the current state of salmon stocks. These measures would be delivered alongside work in other areas by the Environment Agency and its partners. This work aims to improve marine survival, reduce exploitation, safeguard sufficient flows, remove barriers to migration and enhance habitat, and maximise spawning success by improving water quality.

1. Introduction

This document describes the fisheries management principles applied by the Environment Agency and the recent status of salmon and sea trout stocks in the River Derwent, to inform the review of the time limited rod fishery byelaws that expire on 24 July 2023. The document draws on the relevant data and presents fishery management options for the appropriate protection of stocks.

Salmon Management

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. 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).

Salmon stocks in England are managed in line with the guiding principles that are set out by the North Atlantic Salmon Conservation Organisation[1] (NASCO). **In summary, these guidelines indicate that conserving the productive capacity of individual river salmon stocks should be given priority over exploitation. The guidelines further state that fishing should not be permitted on stocks which are below their Conservation Limits (defined below) and take precautionary action where data may be uncertain.** Further information on the NASCO guidelines relating to salmon fisheries management are available at: http://www.nasco.int/pdf/far_fisheries/Fisheries%20Guidelines%20Brochure.pdf

However, if a decision is made to allow fishing on a stock which is below its Conservation Limit, on the basis of overriding socio-economic factors, fishing should clearly be limited to a level that will still support stock recovery within a stated timeframe.

The status of stocks in the principal salmon rivers in England are assessed annually against Conservation Limits and Management Objectives. The Conservation Limit is river specific, and defined as the minimum spawning stock level, below which stocks should not be allowed to fall. The Conservation Limit 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. The Management Objective used for each river in England is that the stock should be meeting or exceeding its Conservation Limit in at least four years out of five (i.e. >80% of the time), on average.

The results of these annual assessments are used as a basis for identifying the need for management and conservation measures. The methods used are described in Annex 7 of the annual 'Assessment of Salmon Stocks and Fisheries in England and Wales' (the 2021 version of which is now available online) and are reproduced in Appendix 1 of this document.

In summary, the Conservation Limit is considered to be the minimum safe level of spawning salmon for each river. By regularly failing to reach this limit, the risk of that river's salmon stock suffering serious decline greatly increases.

[1] North Atlantic Salmon Conservation Organisation 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.

Because salmon stocks naturally vary from year to year, the Environment Agency aims to ensure that stocks meet the Conservation Limit in four out of five years on average; this is the Management Objective as set out above.

It is also important to look at the trend for a particular spawning stock, whether it is stable, improving or deteriorating. Stocks are therefore classified according to whether, on the basis of the spawning stock trend over the past 10 years, they are likely to meet the Management Objective in five years' time. This system is used because it gives an early warning of where a river's salmon stock will be, if current trends are maintained. On the basis of this annual compliance assessment, stocks are allocated to one of four categories based on the likelihood of meeting the Management Objective. These are set out in Table 1.

Table 1: Likelihood of meeting the Management Objective and the associated risk category

Likelihood of meeting the Management Objective	Less than 5%	Between 5% and less than 50%	Between 50% and less than 95%	95% and greater
Category name	At Risk (AR)	Probably at Risk (PaR)	Probably Not at Risk (PNaR)	Not at Risk (NaR)

To assist in determining the appropriate level of exploitation for a river's salmon stock, a salmon fishery management Decision Structure (Appendix 1) was established and has been in use since 2007. The Decision Structure helps to guide a consistent approach to the implementation of management measures and seeks to manage exploitation at a sustainable level that promotes stock recovery, whilst minimising the social and economic impacts of measures to control exploitation. This approach is endorsed and supported by DEFRA.

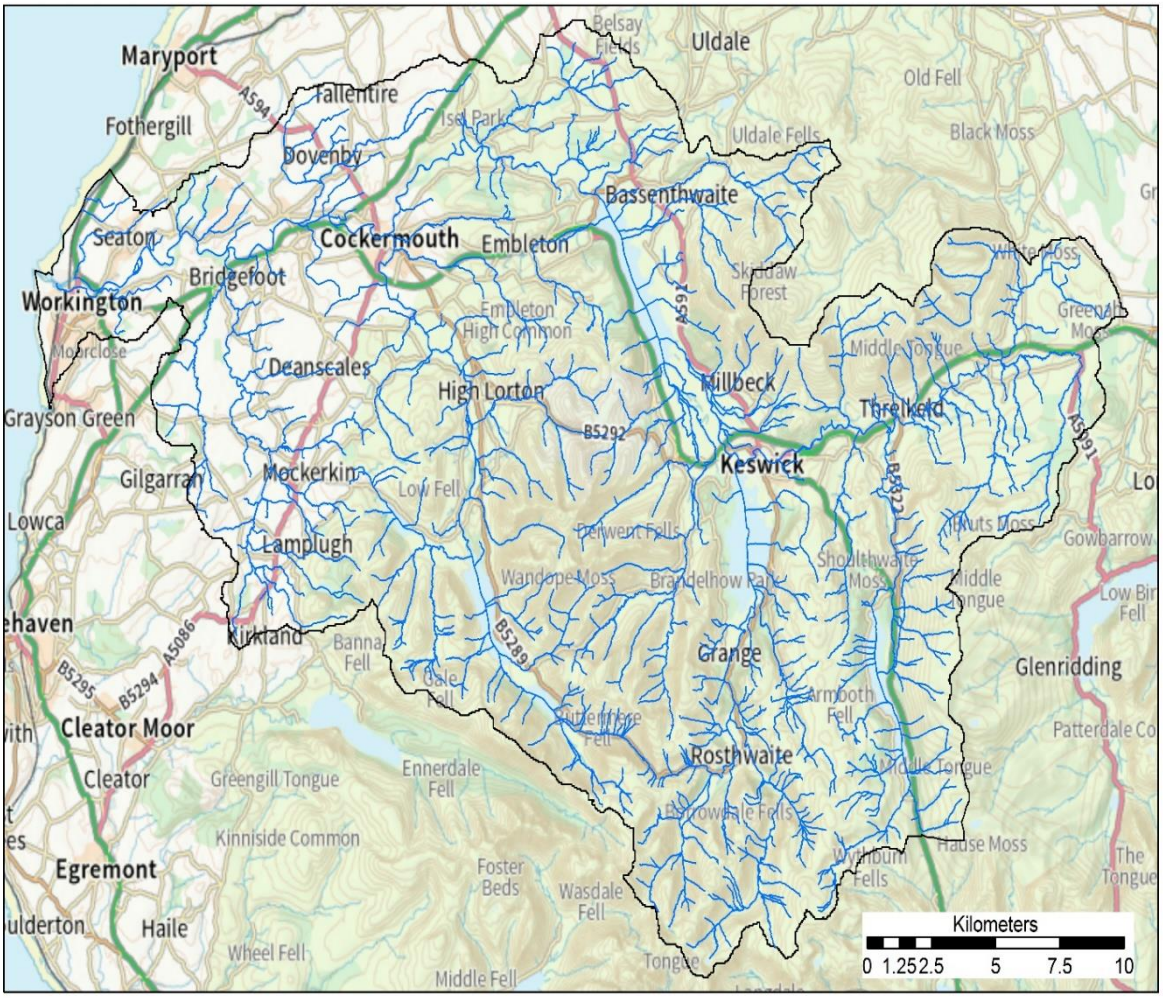
1.1 The River Derwent catchment and fisheries

The River Derwent rises in the Cumbrian Lake District fells. Its origin lies at Sprinkling Tarn (NY2266509079), to the north of Great End and at an altitude of 603 metres. The river then flows broadly northward along the Borrowdale valley, through both Derwent Water and Bassenthwaite Lake, then turning westward, entering the Irish Sea at the Port of Workington. Flowing for a total of approximately 133 km, the main Derwent has three key tributary catchments, namely the Rivers Greta, Marron, and Cocker. The Derwent catchment is a designated Special Area of Conservation (SAC), as set out by the Conservation of Habitats and Species Regulations (2010, as amended in 2017) England and Wales. Atlantic salmon are a primary reason for this designation, and this places additional emphasis on their management and protection.

Catchment background

The Derwent catchment benefits extensively from a very active partnership-based focus on habitat and environmental improvement. These partners individually and collaboratively undertake numerous and widespread projects, benefitting habitat within the catchment for a range of flora and fauna. Projects include, but are by no means limited to, improvement of riparian habitat, removal of weirs and barriers to fish migration, and creation of in-river and in-lake refuge.

Notably, the Derwent catchment has recently been the study area for a salmon smolt tracking project. The Environment Agency planned and initiated the project, with significant support from members of the River Corridors Group. The research is led by a PhD researcher from the University of Glasgow and has tagged approximately 400 salmon smolts (and some additional sea trout smolts), between 2020 and 2022. This study aims to examine the loss rates of smolts on their downstream migration in relation to environmental variables and also in relation to man-made structures. Additionally, and importantly, the study has been timed to coincide with the deployment of marine arrays of compatible tag receivers between the coasts of Northern Ireland and western Scotland, to provide the ability to detect these tagged Derwent smolts during their early migrations at sea. Data from this research will be used to inform relevant management and project priorities in the coming years.



Map 1: The Cumbrian Derwent catchment

Fisheries and existing legislation

The River Derwent catchment supports a number of rod and line fisheries. These fisheries are principally focussed on Atlantic salmon (*Salmo salar)* and Sea/Brown Trout (*Salmo trutta*). Derwent Water and Bassenthwaite Lake support coarse fish species, which are also the target of angling activity. Coarse fishery byelaws are not being reviewed within this document.

No net, or any other type of commercial salmonid fishery currently operates within the River Derwent catchment or near coastal area. Historically, salmon and sea trout traps were fished in the lower river area around Workington, but these are no longer operational. Rod and line angling is the only current, permissible fishing method.

Salmon and sea trout

The rod fishing season for salmon on the Derwent catchment runs from 01 February to 31 October each year. For sea trout, the season runs 01 April to 31 September. Fishing for salmon and sea trout is currently controlled by the National Spring Salmon byelaws, River Derwent Rod Fishery byelaws and North-West and Border Esk byelaws in the following manner:

1. From and including 1 October to 31 October no female (hen) salmon may be retained **(River Derwent Rod Fishery byelaws (2013) – expires July 2023)**

2. No more than 2 salmon may be retained during any day **(River Derwent Rod Fishery byelaws (2013) – expires July 2023)**

3. Salmon may only be retained from the 16 June – 31 October **(National Spring Salmon byelaws (2018) – expires December 2028)**

4. Sea trout minimum size limit of 30cm, and method restrictions such as hook gape size (**North West and Border Esk byelaws – permanent byelaw)**

Recognising the declining salmon stock status at the time, further national byelaw restrictions were applied to defined At Risk salmon stocks in 2018 (December). The River Derwent salmon stock status was Probably at Risk at that time, but while no further mandatory controls were placed on the fishery by those byelaws, Derwent anglers were encouraged to improve their voluntary rate of catch and release. In autumn 2018 the Derwent Owners Association (representing the bulk of Derwent fisheries, owners and clubs) enacted a 100% voluntary catch and release policy for salmon.

The SAC designation of the Derwent catchment places an additional requirement on regulatory bodies such as the Environment Agency to, where possible, maintain and restore the habitats and population status of salmon in the Derwent to favourable condition. Any new plan or project that has the potential to impact the salmon stock, including this proposed amendment to fishery regulations, will be required to consider this obligation.

The scope of this document is to review the current **River Derwent Rod Fishery byelaws (bullets 1 and 2 above)**. The current byelaws expire on 24 July 2023. Thus, there is a need to review them in the context of the current stock data and consider if new regulations are appropriate.

2. River Derwent salmon stock

2.1 Rod catches

The main metric by which salmon and sea trout stocks are determined is rod catch data. This data is that provided by salmon and sea trout anglers via statutory catch returns. Catch returns report key statistics such as catch, and associated effort, and are typically reported in the latter part of the year or early within the next. At the time of writing, data up to and

including 2021 is available. Data for 2021 is provisional, and although very unlikely to change significantly, will be finalised during stock assessments for 2022.

Figure 2.1 shows declared annual salmon rod catch of the Derwent catchment, 1993-2021.

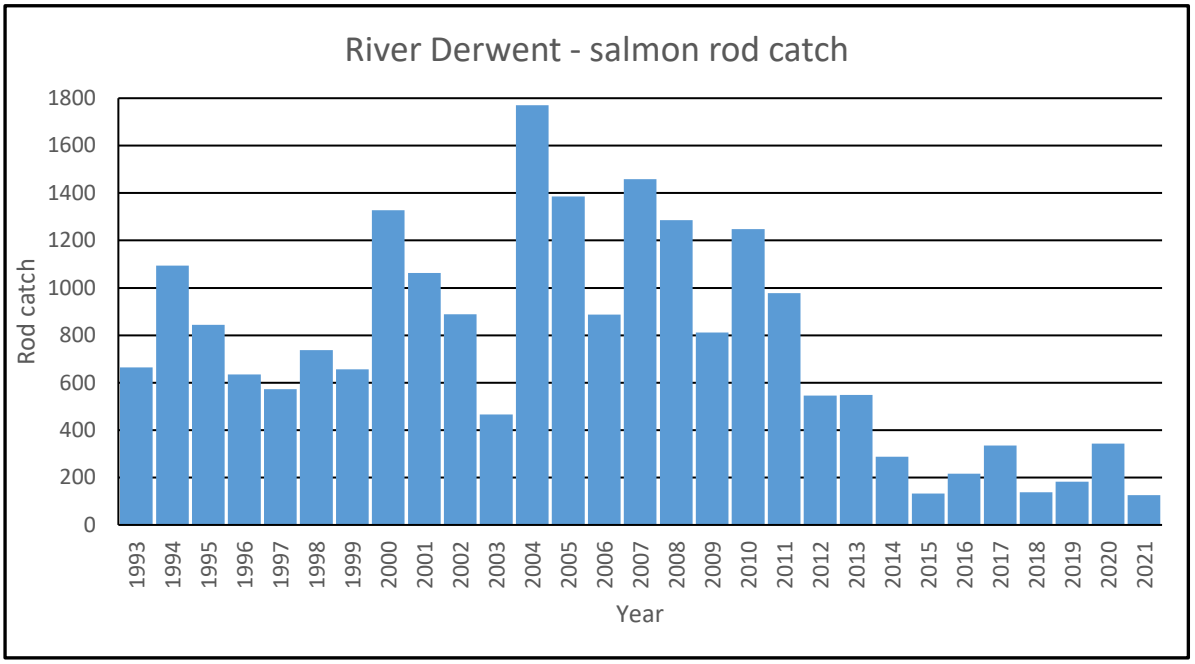


Figure 2.1: Derwent salmon annual rod catch**. Note**: Data for 2021 is provisional

These catches can be broadly characterised into three phases. From 1993-2003 the average annual catch was 813 salmon. Catches increased between 2004 and 2011, with an average of 1228. From 2012 to 2021 there was a marked drop in annual salmon rod catch, with an average of 285. Catches within this phase are the lowest on current record.

Figure 2.2 below shows monthly rod catch from 1999-2021[2]. Most Derwent salmon are traditionally caught during summer and into the early autumn. These make up the bulk of annual catches. A smaller number of salmon are caught early in the season.

The key months for catches are August, September, and October. Catches in these months show a decline to lows in the most recent decade. This reflects observations from the Derwent, and elsewhere, of reduced abundance of summer and autumn runs of fish. Whilst angling opportunity has been limited in some recent years due to dry weather, the decline is such that it is likely to represent a genuine lack of adult fish, rather than simply fewer fishing opportunities.

In summary, the most recent 10 years have seen the lowest salmon catch on record. The Derwent salmon fishery is currently performing considerably worse than it has done in relatively recent history.

[2] In some years, a small percentage of fish (up to a maximum of 5% of total rod catch in 2017) have not been reported with a capture date. These fish are not included in the graphs in figure 2.2, so the graphs do not represent 100% of rod catch in all years. The distribution of captures with unknown/erroneous dates are likely to be similar to the pattern shown by those with associated dates.

Figure 2.2: Monthly Derwent salmon rod catch 1999-2021. **Note**: January captures are likely to either be a date reporting error, or possibly out of season captures whilst the angler pursued other species.

2.2 Derwent salmon angling effort

As part of their catch returns, anglers provide data on angling effort each season. It is important to take this effort into account when reviewing stocks based on catch data. Figure 2.3 presents the annual declared salmon rod catch on the Derwent catchment, alongside available data on the total number of days fished (effort) for salmon and/or sea trout, and total number of returns submitted. Whilst reported effort represents the fishing for both species combined, a high proportion of effort within the Derwent catchment is focussed on salmon. Fishing effort and number of catch returns submitted have declined since 2010, with effort falling to lows in 2015, 2018 and then again in 2021.

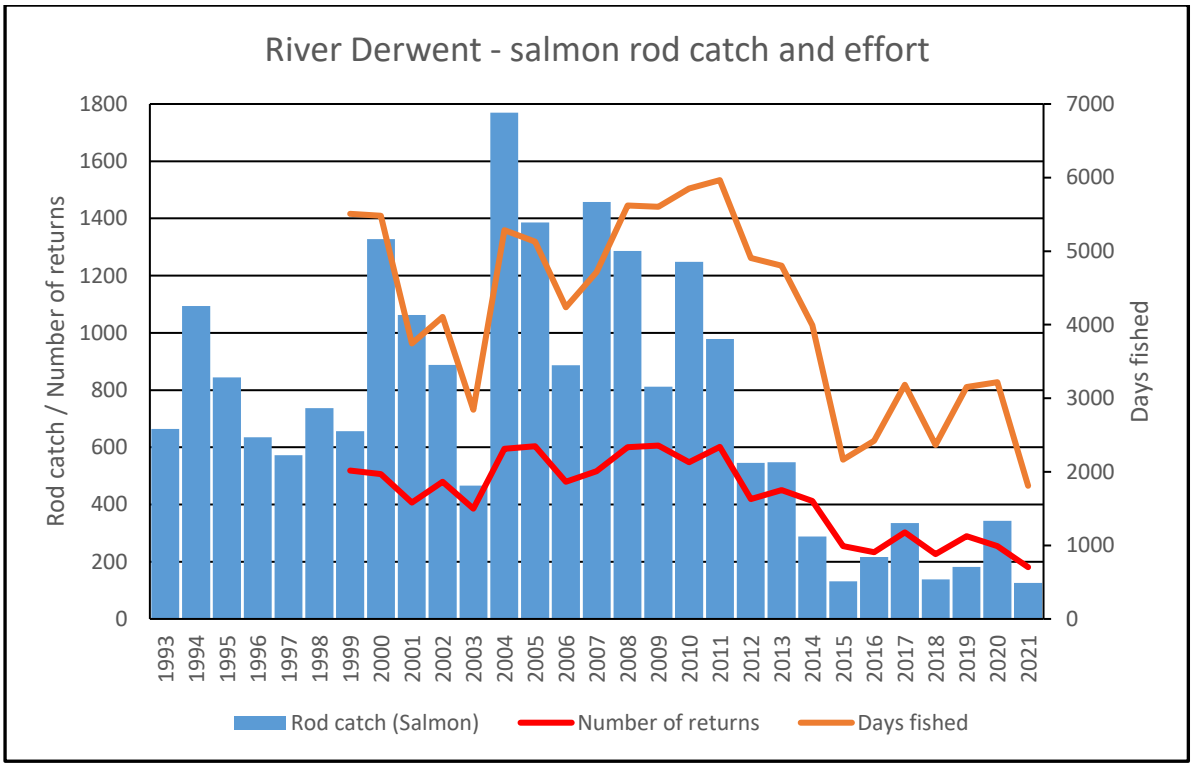


Figure 2.3 Derwent catchment declared salmon rod catch, total days fished by year, and number of returns submitted.
Note – total days fished is likely to be an under-estimate, because some anglers fail to report effort within their catch returns each year.

Catch per unit effort

Considering the decline in angling effort running concurrently with a decline in salmon catches within the Derwent catchment, it is important to try to gauge the relationship between the two. A lower number of days fished will to some extent, lead to a lower number of fish caught. However, this relationship is not straightforward. Differing levels of angler success governed by factors such as ability and experience, mean that declining effort will not simply lead to proportional declines in rod catch. Many anglers, in fact often a majority, report a zero catch of salmon each year (see figure 2.7 later in this section).

One mechanism by which the relationship between effort and rod catch can be demonstrated is through examination of the salmon catch per unit of effort (CPUE). This calculation standardises catches by effort thereby controlling for effort fluctuations. This metric provides a valuable proxy of salmon abundance, and can help identify whether overall

rod catches are simply declining due to less angler participation, or whether fewer salmon are actually available in the fishery, and thus fewer are caught for the same unit of effort.

Figure 2.4 displays the catch of salmon per 100 days fished on the Derwent catchment from 1999-2021. The '100 days fished' is the standard unit of time used in this exercise.

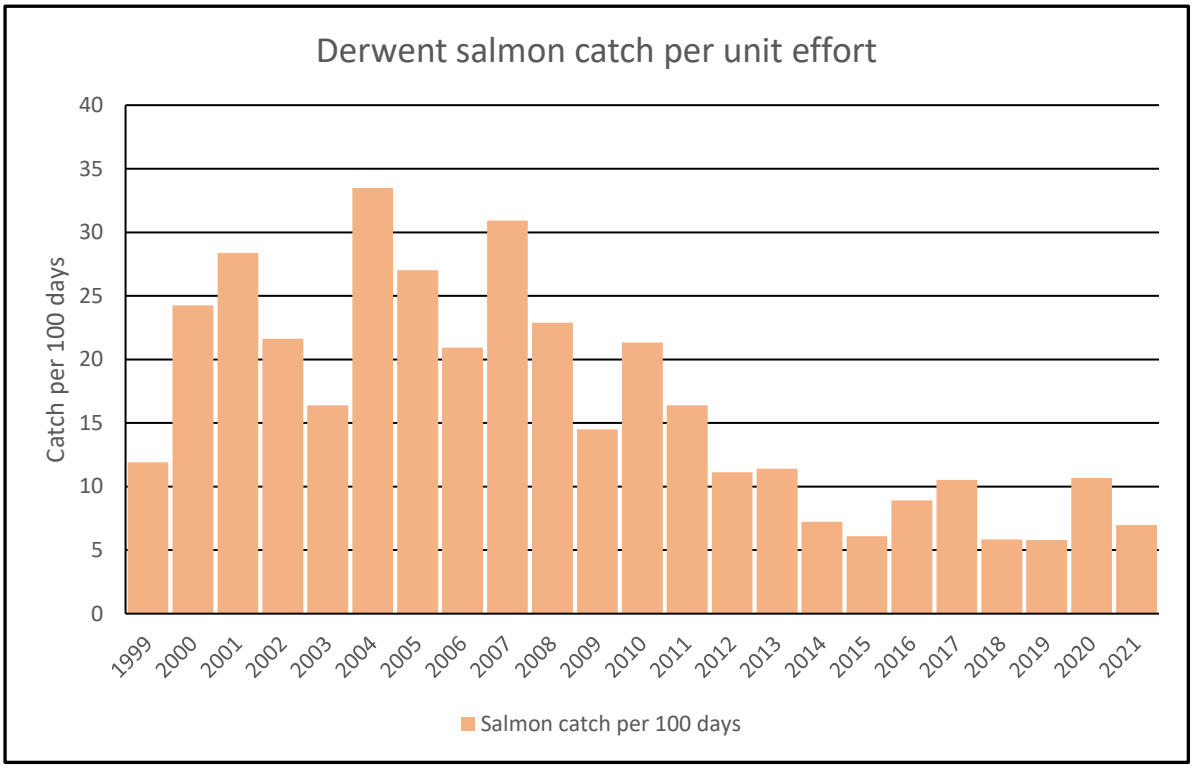


Figure 2.4: Derwent salmon rod catch per unit effort (100 days fished) by year

Since 2004, there has been a downward trend in the salmon CPUE on the River Derwent. That is to say, for the same unit of angling effort each season, there has been a general reduction in the number of salmon caught, to particular lows in recent years.

This analysis illustrates that it is likely that a decreasing number of fish were available to be caught by the anglers over this period. This likely reflects a genuinely lower number of adult fish within the catchment and demonstrates that decreasing rod catch is not simply a product of reducing effort. Other factors such as river conditions, may play a role in rod catch, but are unlikely to account for the overall decline in CPUE over this recent period.

Whilst a variety of socio-economic factors impact fishing effort, in a year where salmon are being seen and caught more frequently, then the appeal of the fishery will inevitably increase. Therefore, more anglers will go fishing and spend more time fishing if they perceive a better chance of success. In short, whilst the number of fish caught may be controlled to some extent by effort, the amount of effort is also likely to be broadly indicative of the abundance of salmon in the river that year. Reduced effort over time is a likely consequence of a genuine decline in salmon stocks as well as other socio-economic factors.

In summary, Derwent rod angling effort has reduced over the last 10 years especially, and this will account for some decline in catches. However, this decline is believed to be driven in the main, by a lower abundance of adult fish. This is indicated declining rod catch and falling catch per unit effort over the same period.

2.3 Derwent salmon angling behaviour

Anglers report captures of salmon to the Environment Agency via catch returns each year and indicate whether or not each fish was retained (killed) or released. In recent years there has been a behavioural / cultural shift within salmon angling nationally and locally, with a higher proportion of anglers now releasing the majority, if not all of the fish they catch.

Figure 2.5 below presents the catch and release rate for the Derwent catchment for the full season.

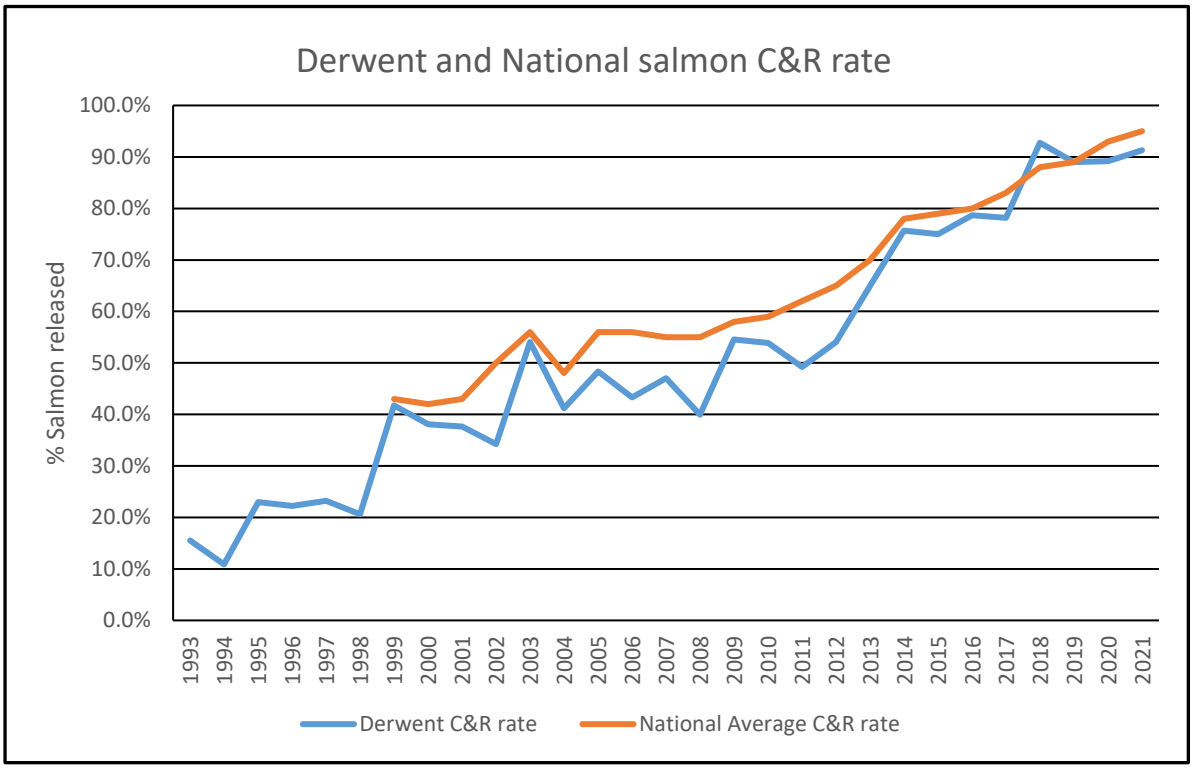


Figure 2.5: The catch and release rate for salmon nationally, and within the Derwent catchment over time

The rate of catch and release angling for salmon on the Derwent has increased over time, perhaps most notably since 2011. Prior to that, catch and release rates rarely exceeded 50%, and were much lower in the earlier years shown. The Derwent catch and release rate generally lagged behind the national average until 2014, since which time it has mirrored it relatively closely, and exceeded it once.

In 2018 The National Salmon and Sea Trout Byelaws were approved. These require catch and release of all salmon where stocks were in the At Risk category. Initially these byelaws had been based on 2016 data, and the Derwent would have fallen into this category at that time. However, delays to the process meant that the 2017 categorisations were used. This placed the Derwent in the 'Probably At Risk' category. This meant that whilst there were no mandatory restrictions applied, Derwent rod fisheries were encouraged to voluntarily achieve a catch and release rate of 100%. In autumn 2018, the Derwent Owners Association promoted a voluntary 100% catch and release policy for salmon.

Clearly, there has been an increase in catch and release rates on the Derwent in recent years. This mirrors the national average and reflects an overall behavioural response amongst salmon anglers and angling clubs to declining stocks of salmon. Derwent catch and

release rates for 2018, 2019, 2020 and 2021 were 93%, 89%, 89% and 91% respectively. While these are relatively high rates of voluntary catch and release, they do fall short of the 100% aspiration.

Angling methods

Rod and line salmon angling on the Derwent catchment is undertaken through a variety of methods. These consist of fly fishing, lure fishing (or spinning), and bait fishing (involving the use of worms, shrimp or prawn). Anglers are required to state which method they used when reporting a capture on their catch return.

Figure 2.6 shows the percentages of the total Derwent salmon rod catch each season taken by fly, lure, and bait. The unknown percentages relate to anglers who declare catching salmon but not stating their capture method.

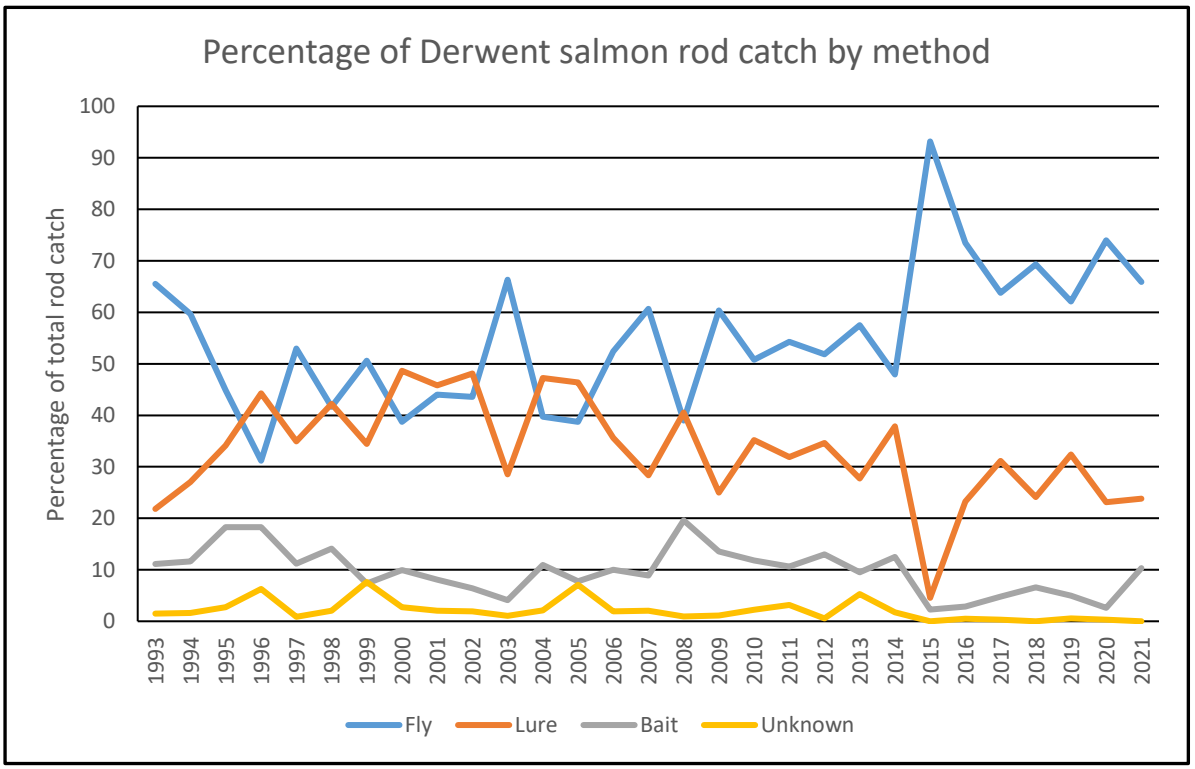


Figure 2.6: Percentage of total Derwent catchment rod caught salmon by method.
Note: Unknowns refer to anglers who declared a salmon capture but did not report the method.

Most Derwent salmon are caught on fly. This has almost always been the case in the context of this dataset, with only a few instances since 1993 in which lure caught fish numbers have slightly exceeded captures on fly. In most recent years, and particularly within the last decade, fly fishing has been by far the dominant method.

There is a low level of bait fishing within the Derwent catchment. This is likely to be due to a combination of private fishery rules, particularly prohibiting the use of shrimp and prawn, and the suitability of the pools/water. A particular decline in bait fishing since 2015 may partly reflect the shifting culture of improving levels of catch and release, with anglers recognising that bait fishing (worming in particular) is the most damaging method by which to catch salmon, and often not compatible with releasing fish.

Angler success

Figure 2.7 presents the number of anglers who have declared fishing on the Derwent catchment. It also displays the percentage of these anglers associated with the catch of at least one salmon, deeming these 'successful' anglers. The figure also shows the percentage of all licences associated with the kill of at least one salmon.

The percentage of anglers catching a salmon between 1999-2010 ranged between roughly 40 and 60%. The data shows a decline in the most recent decade, to lows of around 20% in 2015 and 2018. It is likely that this decline in angler success is primarily driven by reduced adult salmon abundance. Other factors, such as river conditions, will play a part in success levels year on year, but are unlikely to explain the overall declining trend. **Fewer Derwent anglers now catch salmon than in previous years, because fewer salmon now run the river.**

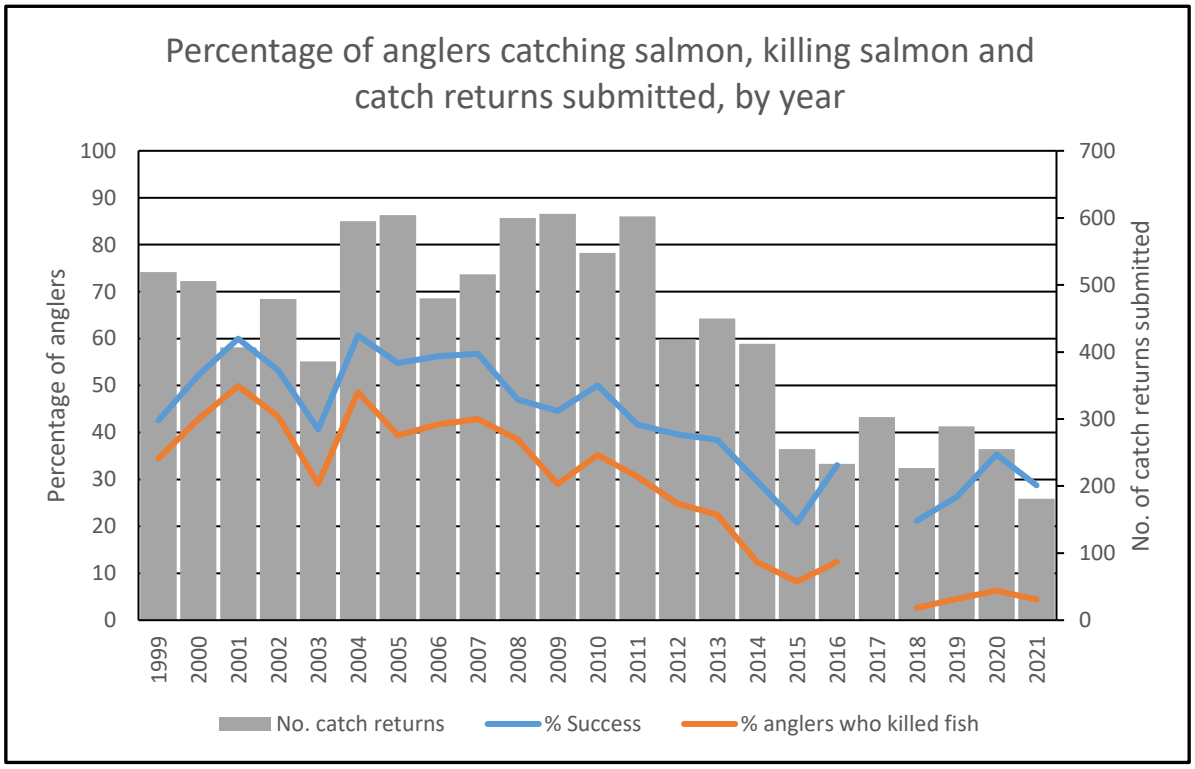


Figure 2.7 - Percentages of total Derwent anglers who caught a salmon, killed a salmon and overall number of catch returns submitted on the Derwent each year.

Note - It is acknowledged that a **small proportion** of the migratory licences used on the Derwent will have been anglers who solely targeted sea trout. It is likely however that this pattern is relatively low and constant, and thus the trend in the data is likely to be accurate. The required data for 2017 are not readily available.

Angler salmon retention rates

Figure 2.8 below shows the percentage of successful anglers who retained (killed) either 0, 1, 2, 3, 4 or greater than 4 salmon, by year. Anglers who did not catch any salmon are not included in this figure.

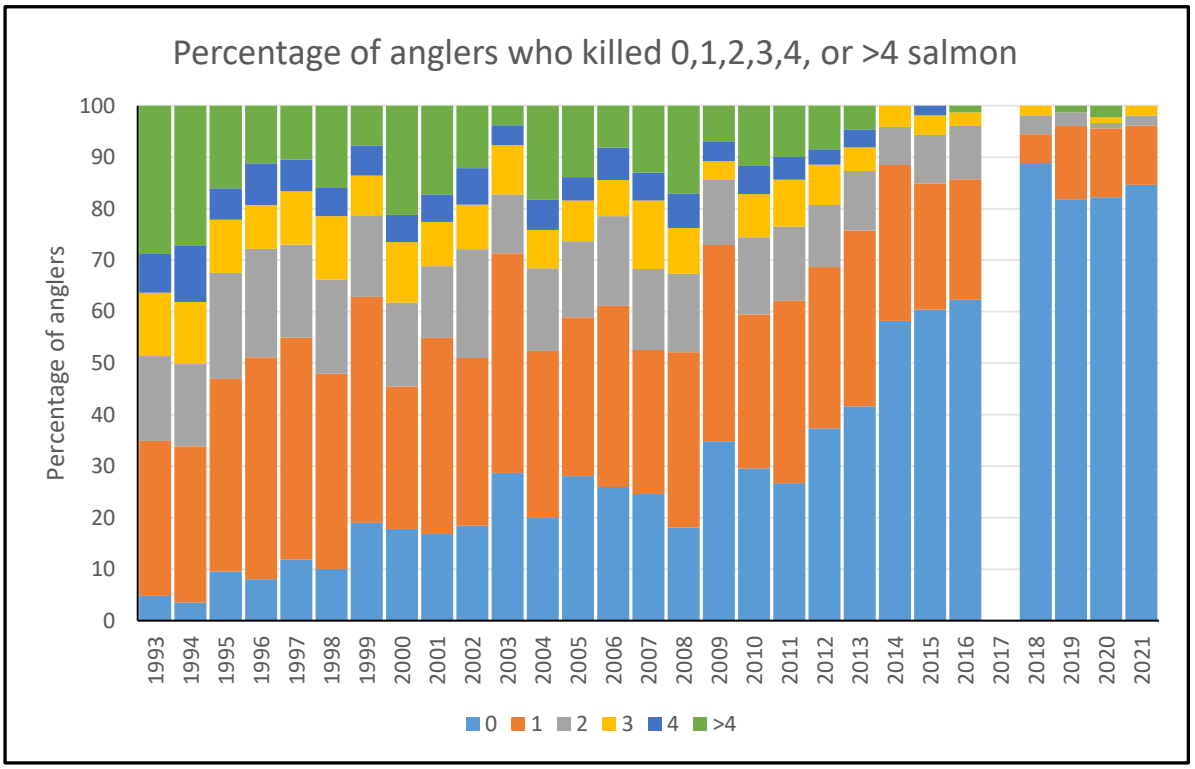


Figure 2.8: Percentages of Derwent anglers who killed 0,1,2,3,4 or greater than 4 salmon, by year. **Note**: This graphic is based only on those anglers who declared catching one or more salmon. Anglers who were unsuccessful are not included within the figure. The required data was not available for 2017.

The percentage of Derwent anglers killing none of their catch has increased over time. Since 2018, over 80% of the anglers who've caught salmon, killed none of them. Of the remaining anglers who did kill salmon, most killed only one. There remains some angler behaviour at odds with this trend, some significantly so. For example, in 2020 (the most prolific of recent seasons);

- twelve anglers killed one fish
- one angler killed two fish
- one angler killed three fish
- one angler killed five fish
- one angler killed fifteen fish

Salmon retention by month

Figure 2.9 below displays the pattern of salmon retention throughout the four most recent years from 2018-2021. The kill of salmon within the fishery is generally distributed throughout the permissible part of the season, though August, September, and October account for most of the fish killed.

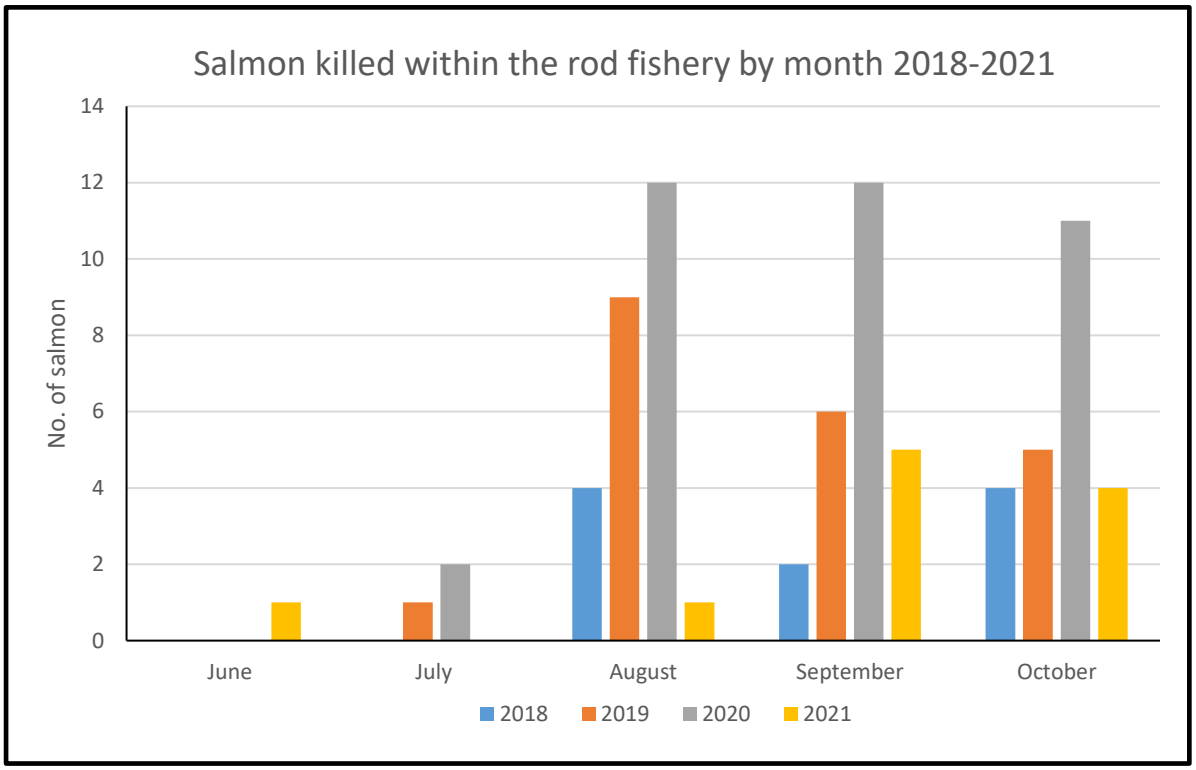


Figure 2.9: Salmon killed within the rod fishery by month 2018-2021

Farmed salmon escapees in 2020 catches

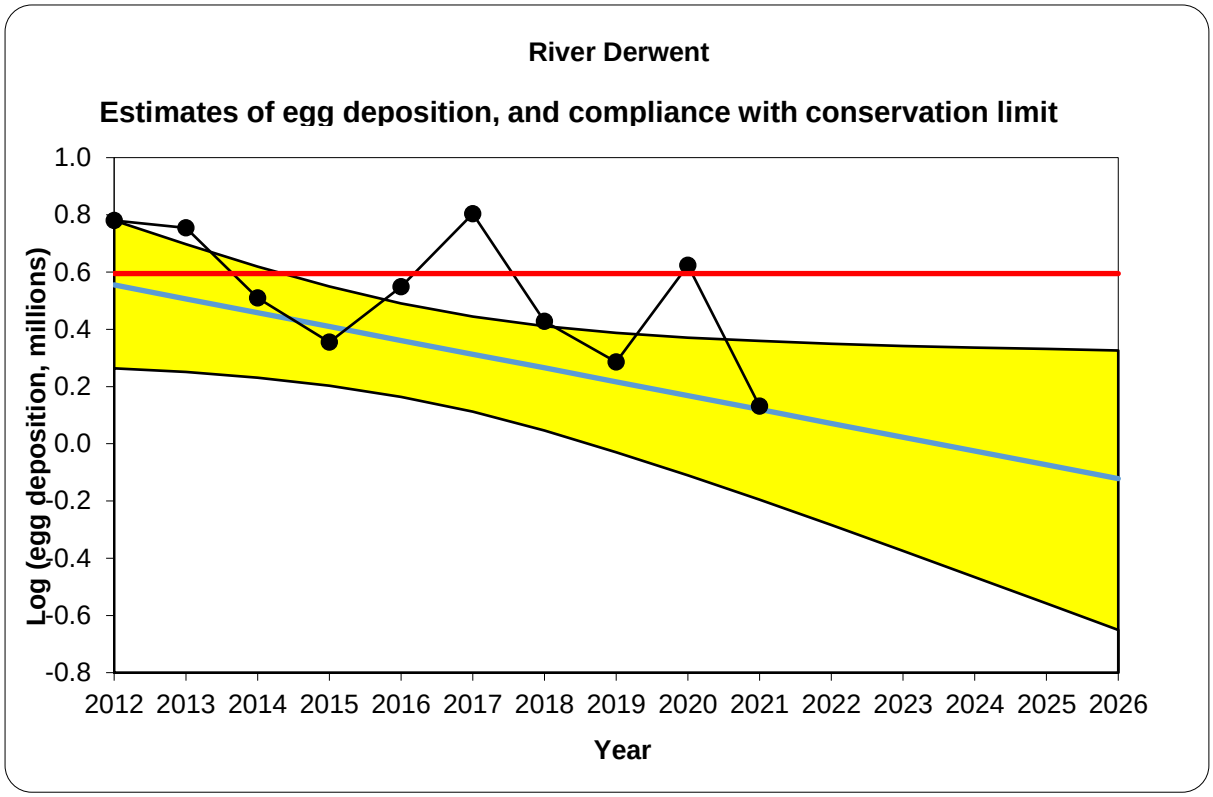
Notably, a substantial escape of farmed salmon from a Scottish fish farm in the Firth of Clyde 2020 led to some anglers catching and killing these farmed salmon on the Derwent. It has been suggested that these could account for the bulk of the overall fish kill for that year, if anglers reported these farmed fish via their catch returns. However, at least 28 of the 37 fish declared killed on the Derwent were either dated before that escape happened or were not consistent with the size of escapees. Therefore, the majority, if not all reported fish killed, were believed to be wild.

In summary, a lower percentage of Derwent anglers now catch salmon than did previously. The percentage of anglers who kill salmon has also decreased, reaching lowest levels in 2018.

Of the anglers who do kill salmon, the majority in most recent seasons have killed only one fish. This is likely to reflect a shift in angler behaviour. There are exceptions to this shift, with a small number of anglers reporting killing larger numbers of fish. The kill of salmon that does occur within the fishery, is distributed across the permissible part of the season.

2.4 Derwent salmon stock assessment

The Derwent salmon stock level is assessed annually. Egg deposition estimates are derived from adult numbers, using angler catch return data. Simply speaking, a trend line with associated probability intervals is applied to the most recent 10 years of data. This is interpreted relative to the Derwent catchment's minimum safe level of spawning (the conservation limit). The relationship of this trend line and probability intervals with the conservation limit places the salmon stock within one of four risk categories and forms the basis for management decisions as defined in the Decision Structure. See appendix 1 for more detailed explanation. Figure 2.10 displays the most up to date egg deposition graph for the Derwent catchment.



Key to Graph	
	20th percentile trend line for egg deposition estimates
	Annual egg deposition estimates
	Conservation limit
	Upper and lower boundaries of the probability interval around the 20th percentile regression line

Figure 2.10: 2021 Egg deposition compliance graph for the River Derwent

In figure 2.10, the upper limit (95th percentile) of the probability interval around the trend line is below the Derwent conservation limit in the forward forecast. This means that there is a >95% probability that the Derwent salmon stock will not meet its conservation limit in four years out of five, and thus will not achieve the management objective (see introduction or appendix 1). **Consequently, the Derwent salmon stock is formally placed in the 'At Risk' category. Given the declining trend, the Derwent salmon stock is also predicted to remain in this category in 5 years' time.**

Habitat regulations directive

The River Derwent catchment is a designated Special Area of Conservation (SAC). Atlantic salmon are a primary reason for this designation, and our stock assessments form part of their condition status assessment. Based on the stock assessment as detailed above, **the River Derwent SAC is deemed to be in 'unfavourable condition'**. This places an additional requirement on the Environment Agency with regards to the management of Derwent salmon stock. We are required to maintain and restore designated sites to 'favourable' condition wherever possible, and therefore must consider how fishery management options can contribute to this on the Derwent. Discussion with Natural England with regards to this review of stocks, and proposed fishery management options has taken place.

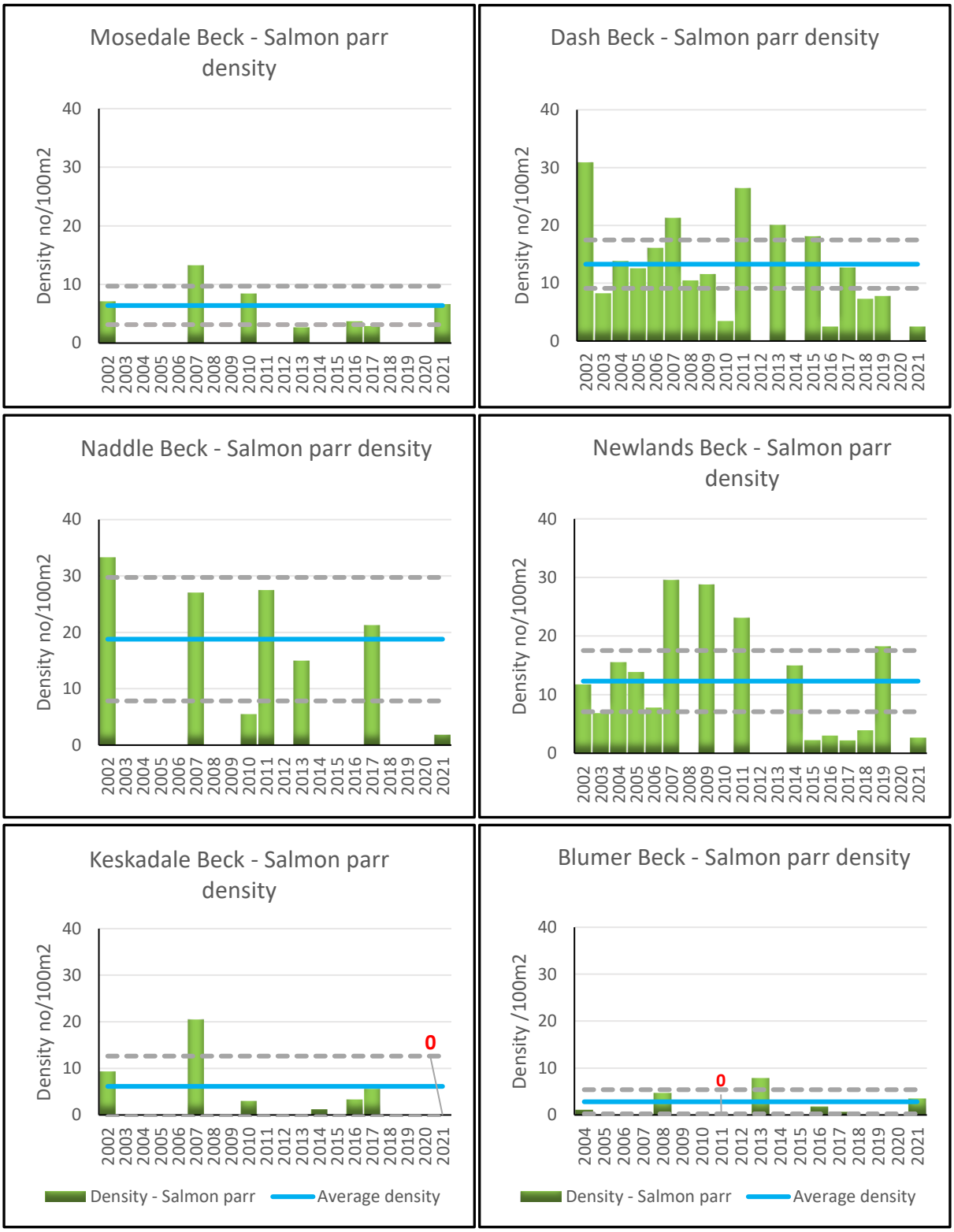
The Conservation of Habitats and Species Regulations (2017) England and Wales require the Environment Agency, as a competent authority, to ensure that any measures introduced will not impact the overall integrity of the designated site or feature or lead to deterioration in site or feature condition. An assessment must be made to demonstrate whether this is likely. This assessment has been undertaken separately and is included with these consultation documents.

2.5 Juvenile salmon monitoring

The Environment Agency undertakes a programme of salmonid monitoring across all principal salmon and sea trout rivers to identify spatial and temporal changes in juvenile fish populations. Juvenile monitoring data reports densities of salmonid fry and parr. Figure 2.11 below shows salmon parr densities at 11 key sites. These sites are spatially distributed across the catchment to be representative of main salmon spawning areas (see appendix 2) and are those which have been sampled most consistently since the mid 1990's. Parr densities are displayed here, as they provide the closest measure to the final smolt production of the river. Fry densities for the same sites are displayed in Appendix 2.

Generally, Derwent catchment salmon parr densities have been variable within each site and between the different sites over the years. Generally, parr densities have declined from higher levels around 10-20 years ago, to levels that are more consistently below the site-specific averages in more recent years, with the exception of the St John's Beck site where parr densities appear to have improved over time. A similar, perhaps more marked declining trend can be seen with salmon fry densities (Appendix 2).

Notwithstanding the generally lower densities in more recent years, there continues to be some very good contemporary salmon fry and parr densities at some individual sites. Some sites e.g. St John's Beck, have achieved their long-term average densities in the most recent surveys and are still performing strongly in a national context. These sites must however, be considered against their own historical performance. That is to say, whilst they are still performing strongly, recent results may not reflect their higher historic potential.


Mosedale Beck - Salmon parr density
Density no/100m2
Dash Beck - Salmon parr density
Density no/100m2
Naddle Beck - Salmon parr density
Density no/100m2
Newlands Beck - Salmon parr density
Density no/100m2
Keskadale Beck - Salmon parr density
Density no/100m2
0
Blumer Beck - Salmon parr density
Density /100m2
0
Density - Salmon parr
Average density
Density - Salmon parr
Average density

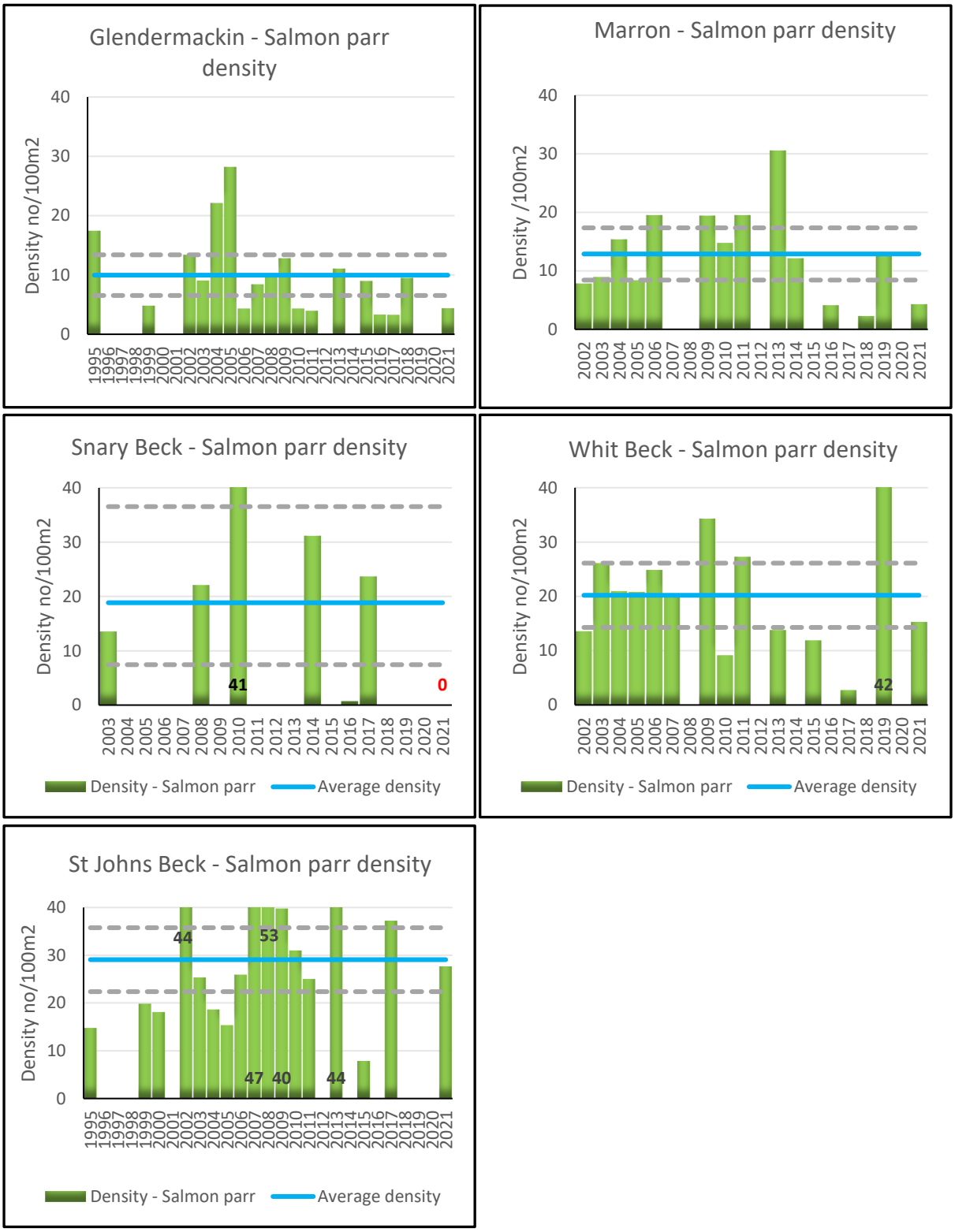


Figure 2.11: Salmon parr densities at 11 regular Derwent catchment electro-fishing sites, including site average density (blue line) and 95% confidence limits (dashed grey lines). These sites were surveyed on seven or more occasions since the mid 1990's.

Note: Surveys that yielded no fish are labelled with a **'0'**. Some sites have been surveyed more frequently than others. The average line reflects the average density at that site specifically.

Adult stock assessments and juvenile data

Figure 2.12 sets out a relationship between estimated egg deposition, and the subsequent average parr densities (from Environment Agency surveys) that were derived from that egg deposition. It is important to note that the parr densities were surveyed two years after a particular year's egg deposition, accounting for the salmon's lifecycle. For example, the 2019 point labelled on the graph relates to egg deposition estimated in 2019, and the parr density recorded in the 2021 survey. It should also be noted that the sites used in this analysis relate to the six key sites that have the longest time series, and not all sites were surveyed in each year. The six sites are highlighted in appendix 2c.

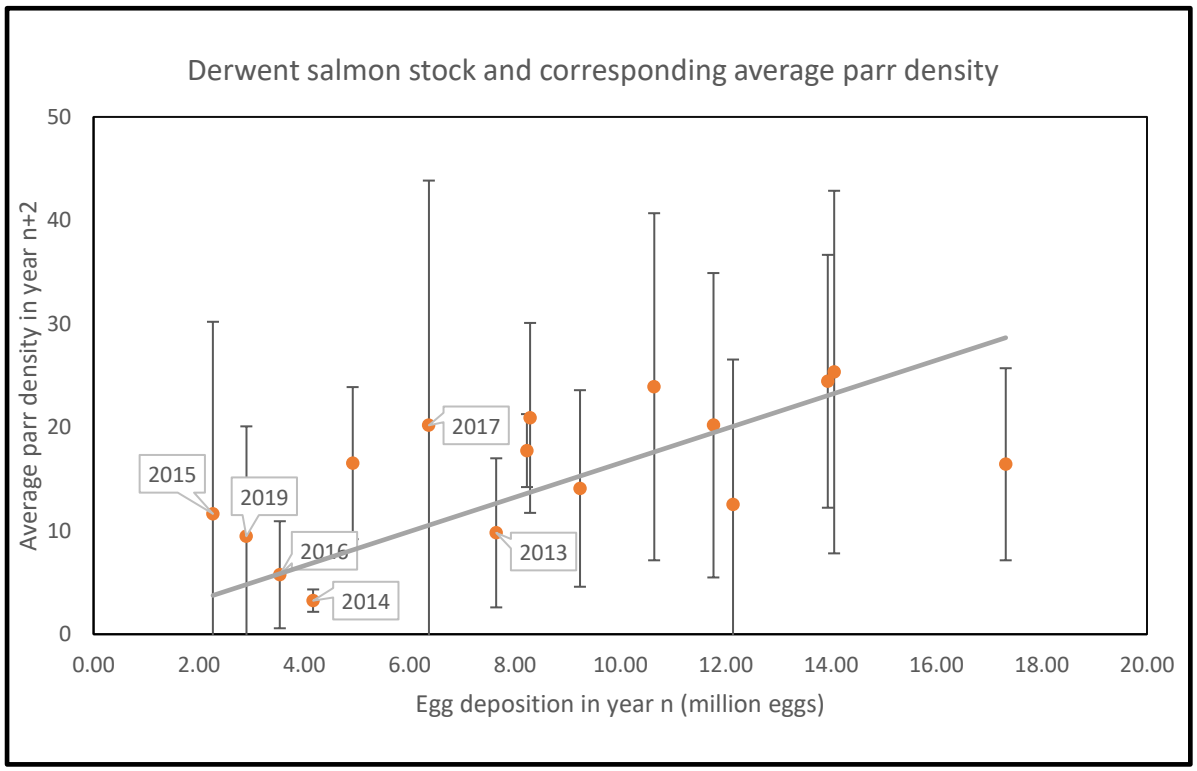


Figure 2.12: The relationship between salmon egg deposition and subsequent average parr densities (with 95% confidence limits) for regularly monitored sites, including linear trendline.
Note: Scheduled surveys for 2020 were cancelled due to the covid pandemic. This means that there are no average parr densities available to compare to the 2018 stock assessment, so no 2018 data point is plotted.

Figure 2.12 suggests that broadly, where our egg deposition estimates are higher, the corresponding years (second summer after spawning) yield higher average parr densities. Where our egg deposition estimates are lower, generally, corresponding parr averages are lower. These average density data are based on between 4 and 6 sites that have been consistently monitored since 2001. Nonetheless, the relationship shown indicates that egg deposition is likely to be an important governing factor in subsequent juvenile abundance. Higher egg deposition levels generally lead to higher juvenile abundance, and lower egg deposition lead to lower juvenile abundance.

A key point in this analysis is the fact that virtually all the lowest average parr densities are derived from the low egg deposition estimates, **and crucially, these have occurred almost exclusively over the last decade**. **In summary, this analysis reinforces the fact that egg deposition is decreasing on the Derwent catchment. It also highlights that this associated with reduced juvenile abundance.**

External sources of fisheries data

The Derwent catchment is fortunate to benefit from a strong partnership approach to its fisheries management. One aspect of this partnership approach is a relatively recent ongoing project delivered by West Cumbria Rivers Trust (WCRT) to complete a large programme of timed electro-fishing surveys. The associated data are too extensive to be reasonably displayed within this document, but are viewable via the WCRT website - West Cumbria Rivers Trust (WCRT) (see Dashboard Maps – Electrofishing Survey Results)

Within this project, WCRT undertake a large number of annual five-minute electro-fishing surveys that focus on fry habitat across the Derwent catchment. These surveys provide an indication of catch of salmon and trout fry per unit of time across a high number of sites each year. This catch per unit effort data from such a large number of sites is useful in building up a picture of relative changes in fry abundance over time. The technique differs from Environment Agency semi-quantitative and quantitative surveys which measure absolute abundance of both **fry and parr** per $100m^2$ of stream area. Five-minute surveys only collect a proportion of the juveniles collected by semi-quantitative or fully quantitative methods. However, the two methods have been calibrated to allow the presentation of results to a comparable standard.

The most recent WCRT report indicates some improvement in salmon fry numbers caught per survey since the programme began in 2015. There is a similar pattern of improvement in fry density at **some of** the 11 Environment Agency monitored sites since 2015 (Appendix 2). However, over the longer term, fry densities have generally lower in recent years than they have been historically. Therefore, whilst a pattern of **some** improvement in juvenile numbers since 2015 is encouraging, where it occurs it must be considered against the historical context and 'site potential' shown by available longer-term data.

In summary, juvenile salmon data on the Derwent indicates a longer term general decline in juvenile densities that is coincident with declining rod catches and estimates of spawning stock. There are some instances of recent improvements in juvenile numbers, but sites are generally not performing at levels they previously did. Whilst numerous factors influence juvenile salmon densities, this overall trend is very likely to be primarily reflective of reducing egg deposition over the same period.

This is reinforced by analysis which indicates that poorer egg deposition estimates correspond with poorer subsequent parr numbers. As a consequence of recent years of lower adult abundance, juvenile habitat within the Derwent catchment is likely to be under-utilised. Therefore, increasing levels of wild adult salmon spawning will be beneficial to the population.

3. River Derwent Sea trout stock

3.1 Rod catches

Figure 3.1 below shows the annual sea trout rod catch on the Derwent catchment from 1993-2021.

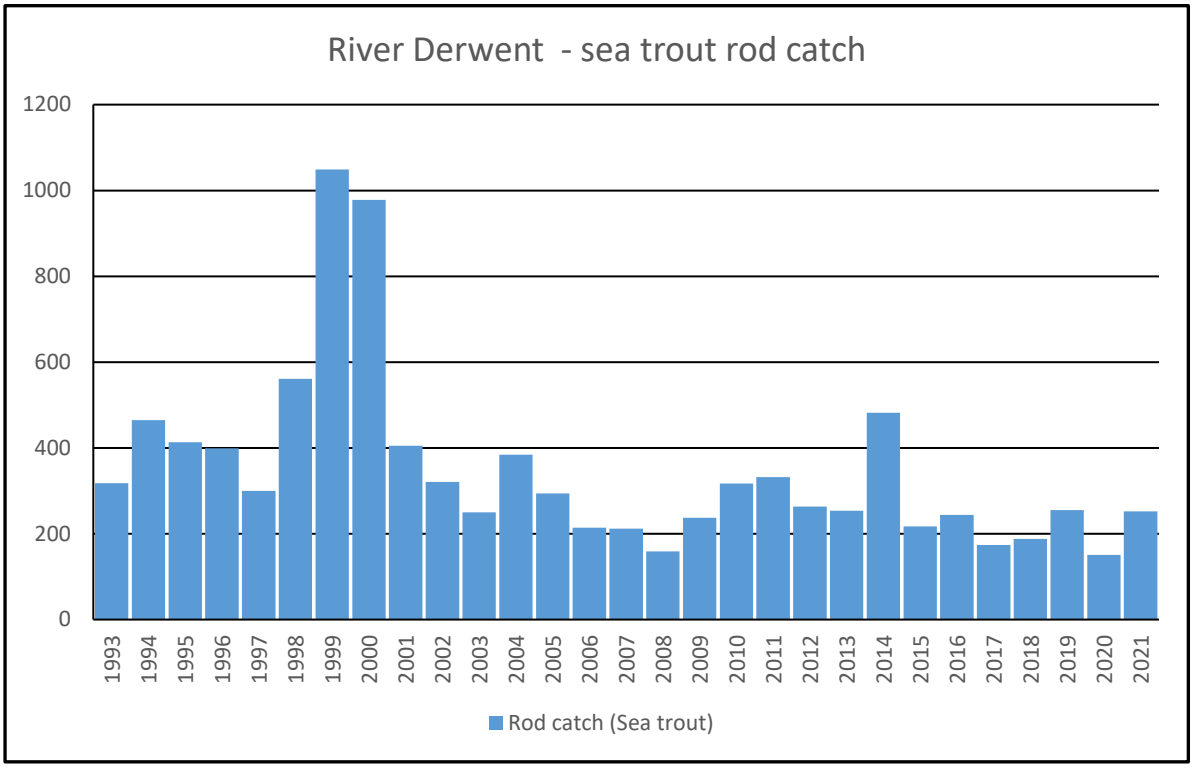


Figure 3.1: Derwent catchment sea trout rod catch 1993-2021

The pattern of sea trout catches on the Derwent catchment since 1993 is different to that of salmon rod catch. There is still a general decline in catches over the time period, albeit without the marked 'drop off' that is evident in salmon catches in the last 10 years. Generally, the data can be described in two phases. Catches between 1993 and 2004 were around, and occasionally far in excess of 400 fish. Since 2004, catches have ranged broadly between 150 and 300 sea trout per year.

Figure 3.2 below sets out the monthly catch of sea trout from 1999-2021[3]. As would be expected, generally most sea trout catch takes place earlier in the season. Over the whole data series (excluding those fish reported without a capture date), an average of around 70% of the total sea trout catch was caught between February and August, with the remaining 30% occurring between September and October. In some years, such as 2014 and 2018, the September-October catch proportion has been as high as nearly 60% of the annual catch. These later season catches, especially those out of season in October, are likely to be reflective of a by-catch by anglers who are primarily targeting salmon.

[3] Not all sea trout captures are reported with a date. In most seasons sea trout captures without a capture date represent either none, or a very small percentage of overall catch. Two exceptions are 2004 and 2021, where a large portion of declared sea trout catch did not include a date. The monthly data displayed in figure 3.2 includes only those fish reported with a capture date

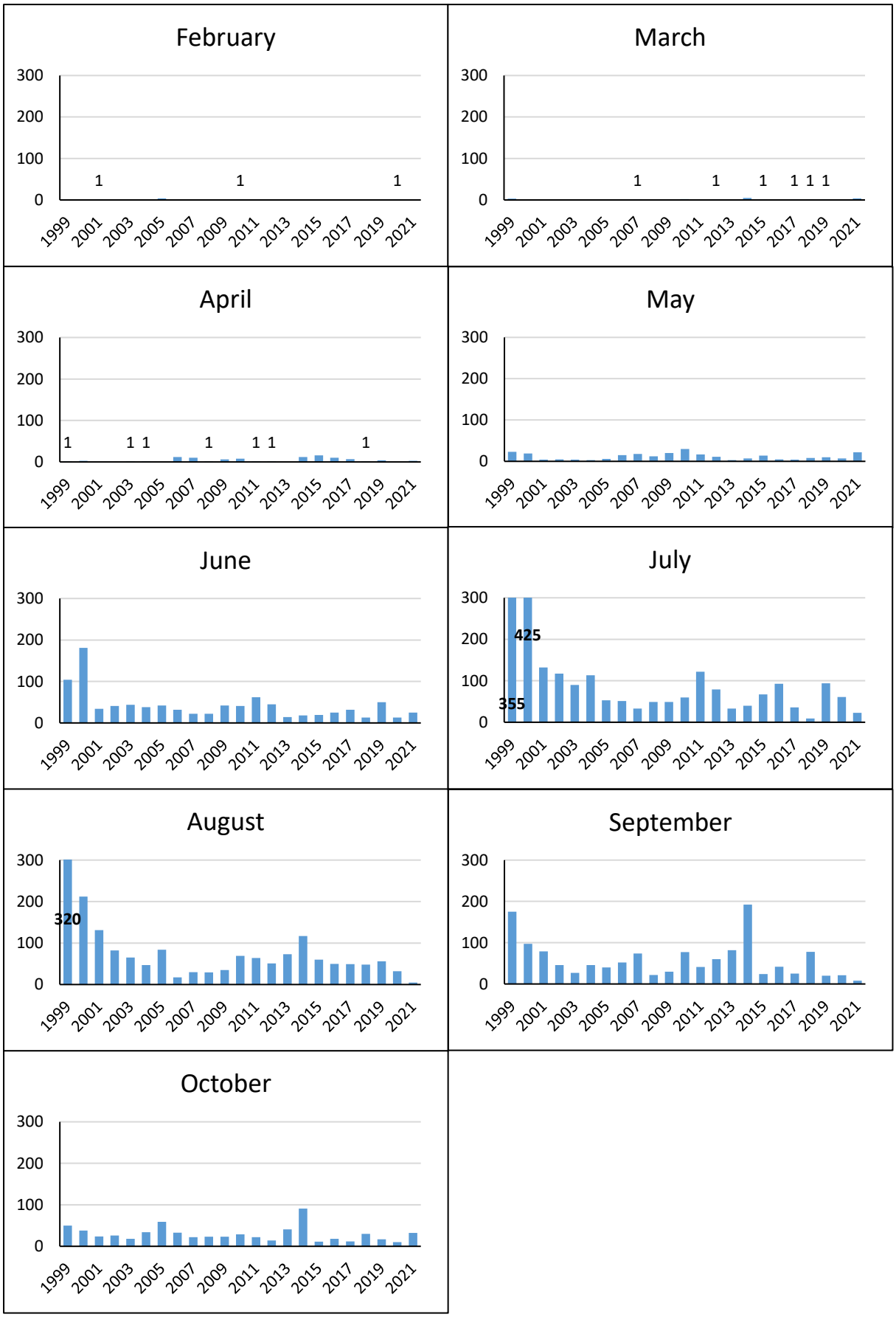


Figure 3.2: Monthly Derwent sea trout rod catches 1999-2021. **Note** – no captures were reported in January over the 1999-2021 period.

3.2 Derwent sea trout angling effort

Figure 3.3 shows Derwent catchment sea trout rod catch, with reported effort. It should be noted that this effort does not distinguish between salmon and sea trout angling. It is likely that the much of the angling effort on the Derwent is associated with salmon.

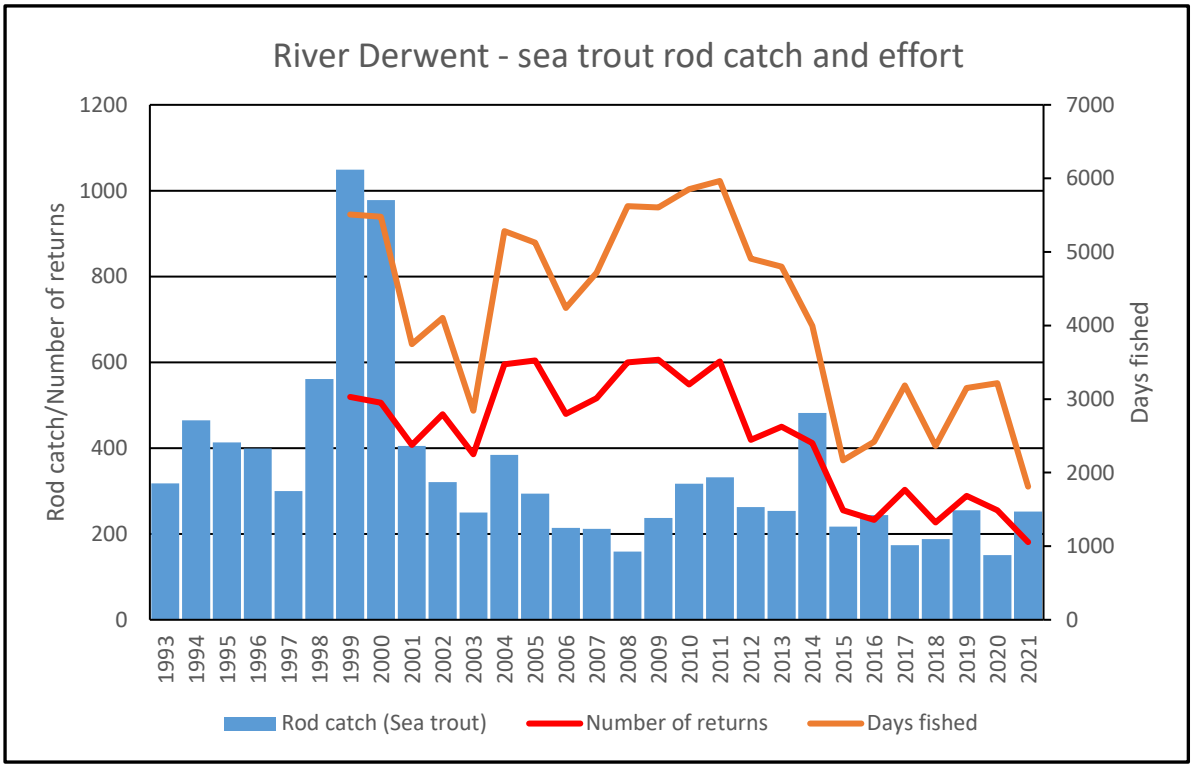


Figure 3.3: Derwent catchment sea trout rod catch, total days fished by year, and number of returns submitted.

Note – total days fished is likely to be an under-estimate, because some anglers fail to report effort within their catch returns each year.

Figure 3.3 does not show a particularly clear pattern or connection over time with effort, number of returns and sea trout rod catch. Effort and number of returns submitted have been at their lowest levels in recent years, and this does coincide with some of the lower levels of sea trout rod catch. However, within this data a decline in effort does not necessarily always coincide with a decline in rod catch. For example, there was a higher sea trout rod catch in 2021 than 2020, despite much lower effort. Similar examples exist in earlier seasons. The fact that sea trout may be caught more as a by-catch by anglers targeting salmon, may explain the lack of pattern within this data.

Catch per unit effort

Catch per unit effort (CPUE), as with salmon in section 2 above, can help critique the relationship between rod catch of Derwent sea trout, and effort. For the Derwent catchment, it must be considered within the context that much of the angling effort is focussed on salmon, with some sea trout captures (especially those later in the season) likely to be a 'by-catch'. CPUE for sea trout is still worthy of consideration, assuming that the rate of this by-

catch is likely to remain fairly constant, and that the rate of targeted sea trout specific effort also remains fairly constant.

Figure 3.4 shows the catch of sea trout per 100 days on the Derwent catchment since 1999. The CPUE of Derwent sea trout is different to that of salmon, in that it shows a slight improvement in recent seasons, from a low in 2008.

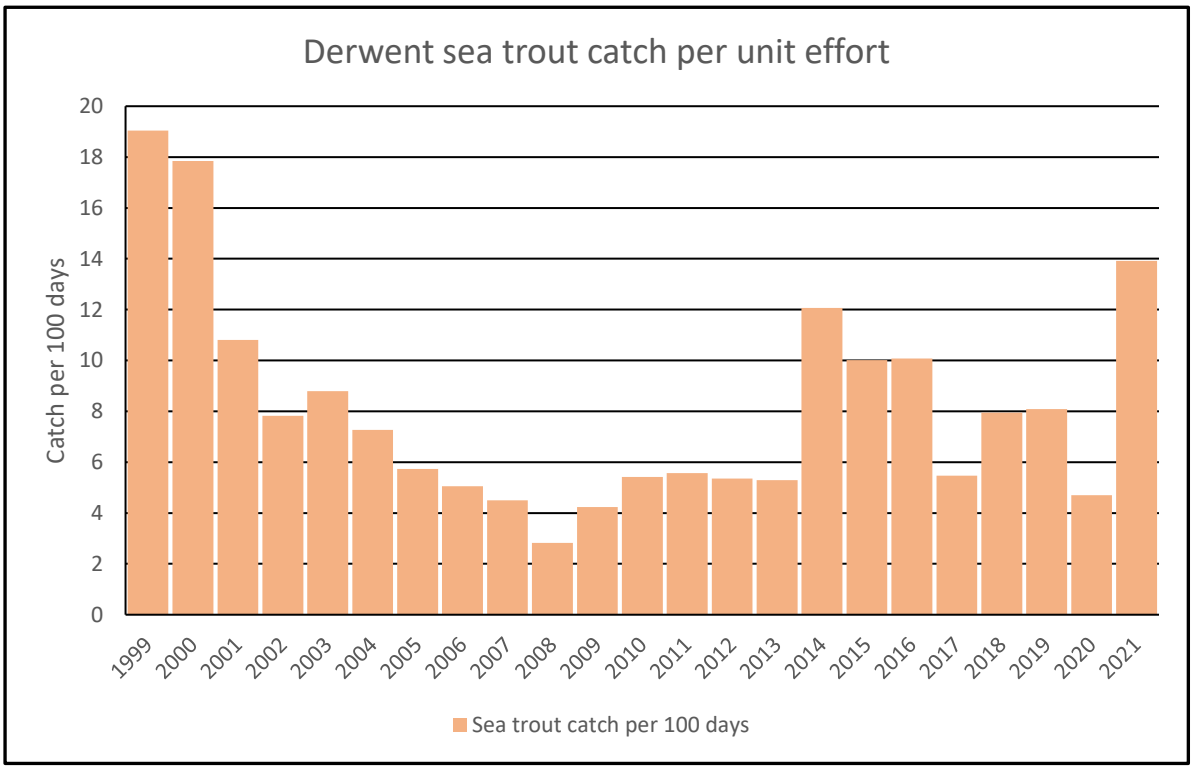


Figure 3.4: Derwent sea trout rod catch per unit effort (100 days fished) by year

Note: Much of the effort reported on the Derwent catchment is focussed on salmon. Analysis of figure 3.4 assumes that out of the overall angling effort each year, a similar proportion of sea trout angling occurs each season, and a similar rate of sea trout by-catch by salmon anglers is occurring.

In summary, although sea trout catches have declined on the Derwent, this decline is very different to that of salmon catches, and not as severe or as marked. Sea trout are unlikely to be the primary target of much of the rod fishing effort on the Derwent catchment. It is likely that a portion of the sea trout rod catch each year is by-catch, accounted for by salmon anglers. Sea trout catch per unit effort shows an improvement in recent seasons, from a low in 2008.

3.3. Derwent sea trout angling behaviour

Catch and release rates

Figure 3.5 shows catch and release rates for Derwent sea trout. Since 2013, sea trout catch and release rates have been around, or higher than 90%, with one notable exception in 2018. In 2020, 100% of sea trout caught were declared released. High catch and release rates for sea trout may in part be due to a large portion of the sea trout catch being taken as by-catch by salmon anglers, later in the season.

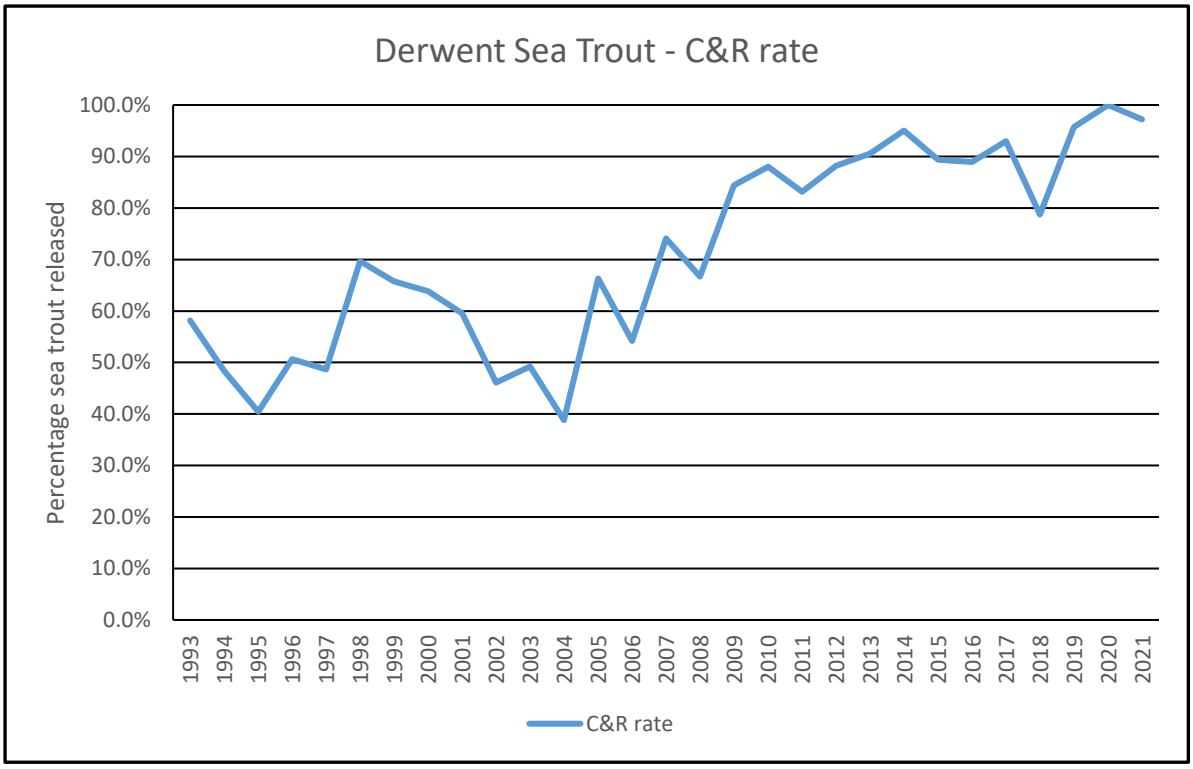


Figure 3.5: Catch and release rates for Derwent sea trout

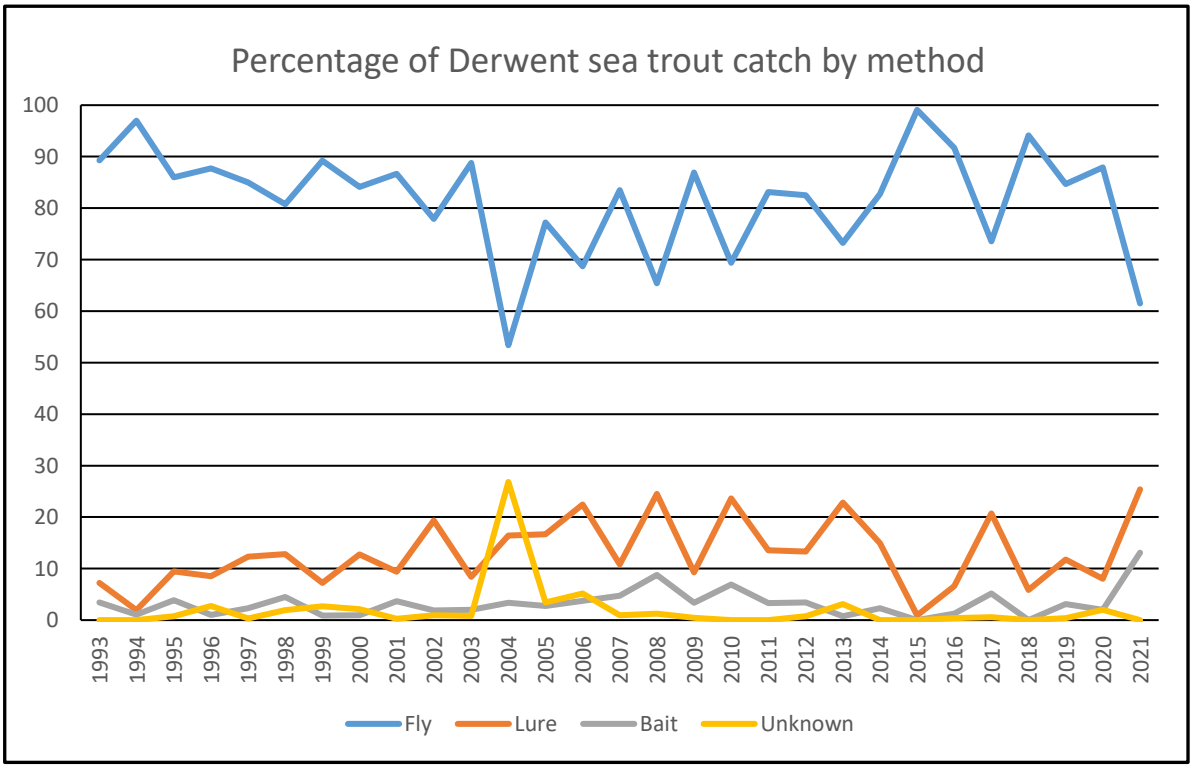


Figure 3.6: Percentage of total Derwent catchment rod caught sea trout by method.
Note: Unknowns refer to anglers who declared a sea trout capture but did not report a method.

Angling methods

Figure 3.6 shows the percentage of sea trout captures, by method, since 1993. Fly is by far the dominant method of capture, though with some variation year on year. This is likely to be explained by differing water conditions and therefore method suitability.

Angling success

Figure 3.7 displays the number of catch returns submitted on the Derwent. It also displays the percentage of catch returns associated with the catch of at least one sea trout, deeming these successful anglers. The figure also shows the percentage of catch returns associated with the kill of at least one sea trout.

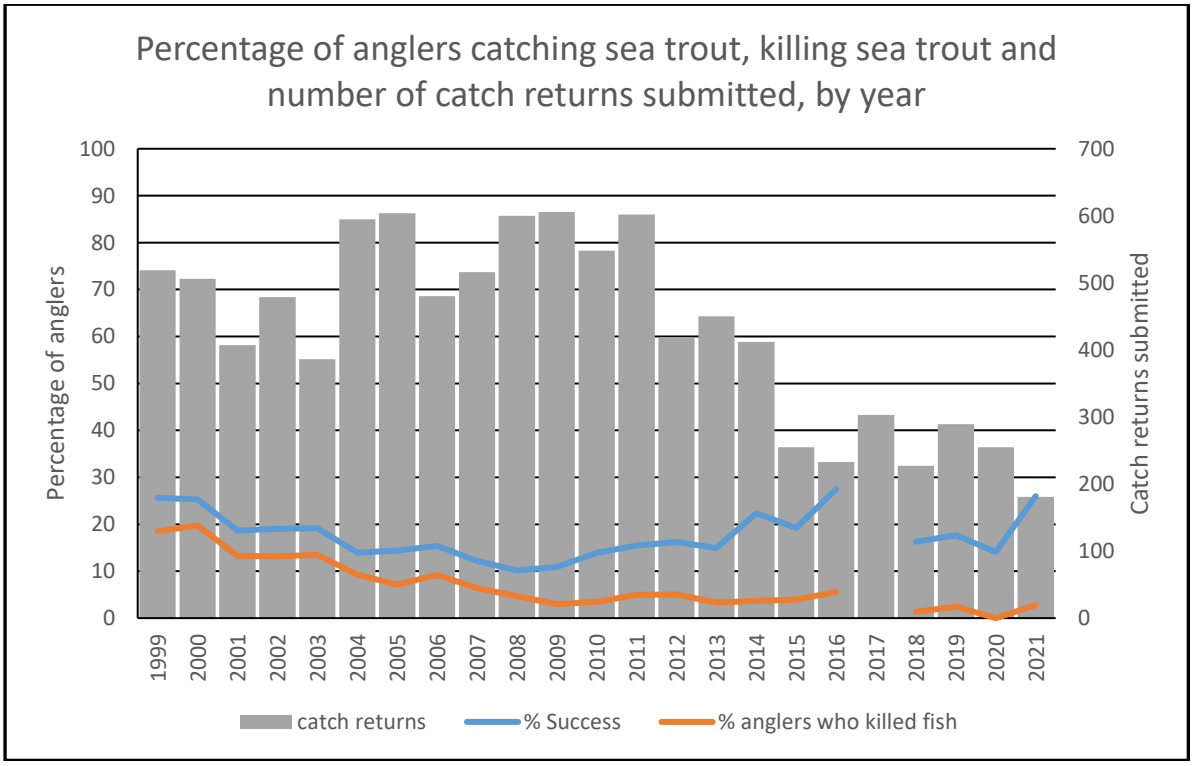


Figure 3.7 - Percentages of total Derwent anglers who caught a sea trout, killed a sea trout and overall number of catch returns submitted on the Derwent each year.

Note - It is acknowledged that **some of** the migratory licences used on the Derwent will have been anglers who solely targeted salmon. This will inevitably contribute to lowering the apparent success percentage with regard to sea trout rod catch. It is likely however that this pattern is relatively constant, and thus the trend in the data is likely to be accurate. The required data for 2017 was not available.

The percentage of anglers catching at least one sea trout on the Derwent catchment has ranged between approximately 10 and 30% since 1993. The data shows a gradual trend of declining success until 2008-2009, and then a gradual increase in success over more recent years to higher levels, peaking in 2016. The percentage of anglers killing sea trout has declined slowly over the time period shown.

Angling sea trout retention rates

Figure 3.8 below shows the percentage of anglers who killed either 0, 1, 2, 3, 4 or greater than 4 sea trout, by year. The data in this figure only reflects successful anglers each year, meaning that anglers who did not catch any sea trout that year are not included within the percentages.

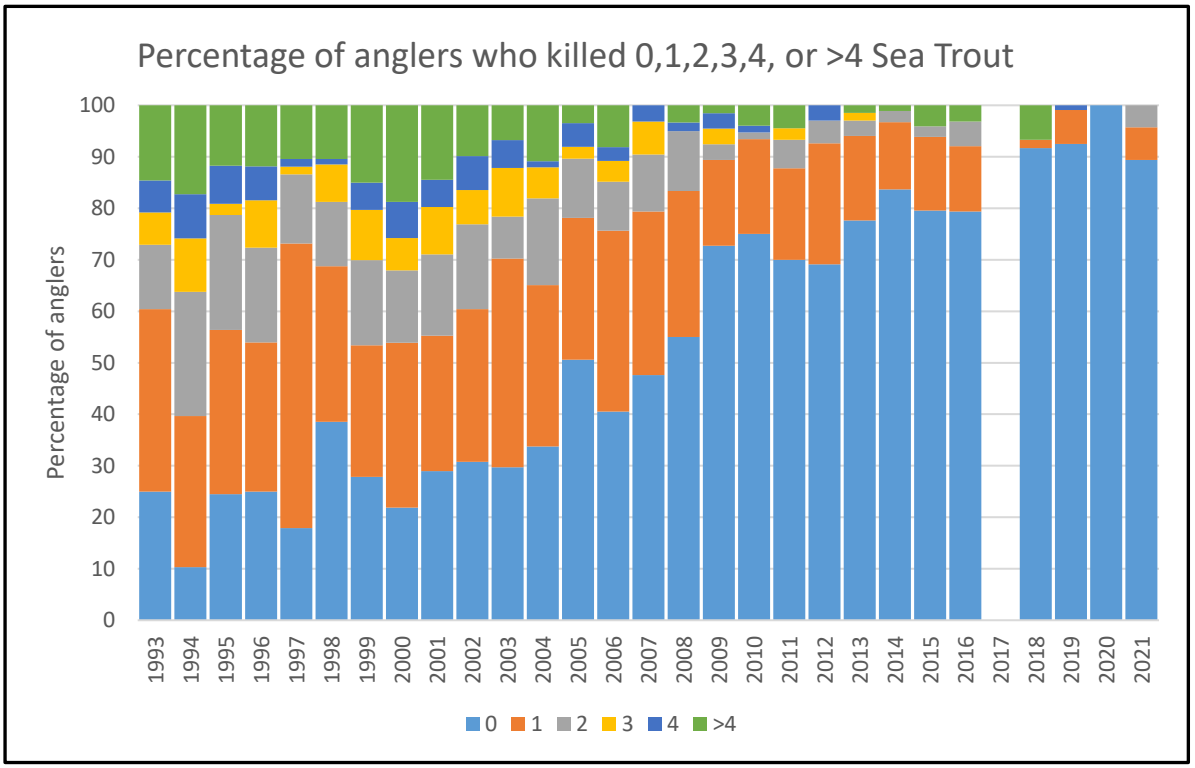


Figure 3.8: Percentages of Derwent anglers who killed 0,1,2,3,4 or greater than 4 sea trout, by year.
Note: This graphic is based only on those anglers who declared catching a sea trout. Anglers who fished, but did not catch a sea trout, are not included in these percentages. The required data was not available for 2017.

Generally, over the past 10-15 years most Derwent anglers haven't killed any of the sea trout they've caught. In most recent years, a minority of anglers have killed one sea trout, with a smaller minority killing more than this. Notably in 2018, the overall trend was bucked slightly. Four anglers killed more than four sea trout, ranging between six and fifteen each. This was unusual and accounted for a large drop in the improving overall catch and release rate. The pattern was not repeated in 2019, with only one angler killing more than four sea trout. In 2020 no sea trout were killed in the rod fishery at all, and in 2021 five anglers killed seven sea trout between them.

In summary, the Derwent catchment sea trout rod catches do not show a marked decline of the same manner as salmon. Whilst sea trout rod catch has been lower in recent years than it has been previously, there is no obvious trend indicating a serious decline in abundance. Catch per unit effort data suggests increased catch rate for sea trout in recent years, as does the broadly increasing percentage of successful anglers over the same period. The majority of anglers release all of the sea trout they catch, with catch and release levels reaching 100% in 2020 and 97% in 2021.

3.4 Derwent sea trout stock assessment

At present, there is no formal stock assessment process for sea trout akin to that undertaken annually for salmon. Work is underway on developing such a process. A more basic stock assessment is carried out each year using two criteria - trend in CPUE (catch per unit effort) in the last 10 years and current CPUE relative to the previous 10 years. The results are classified into 4 categories: 'At risk', 'Probably at risk', 'Probably Not at risk' and 'Not at risk'. There is no forward prediction for status in five years' time as there is with salmon. The assessment is designed to be reviewed in conjunction with other data, such as juvenile monitoring data, to inform management actions.

Derwent sea trout stock assessment

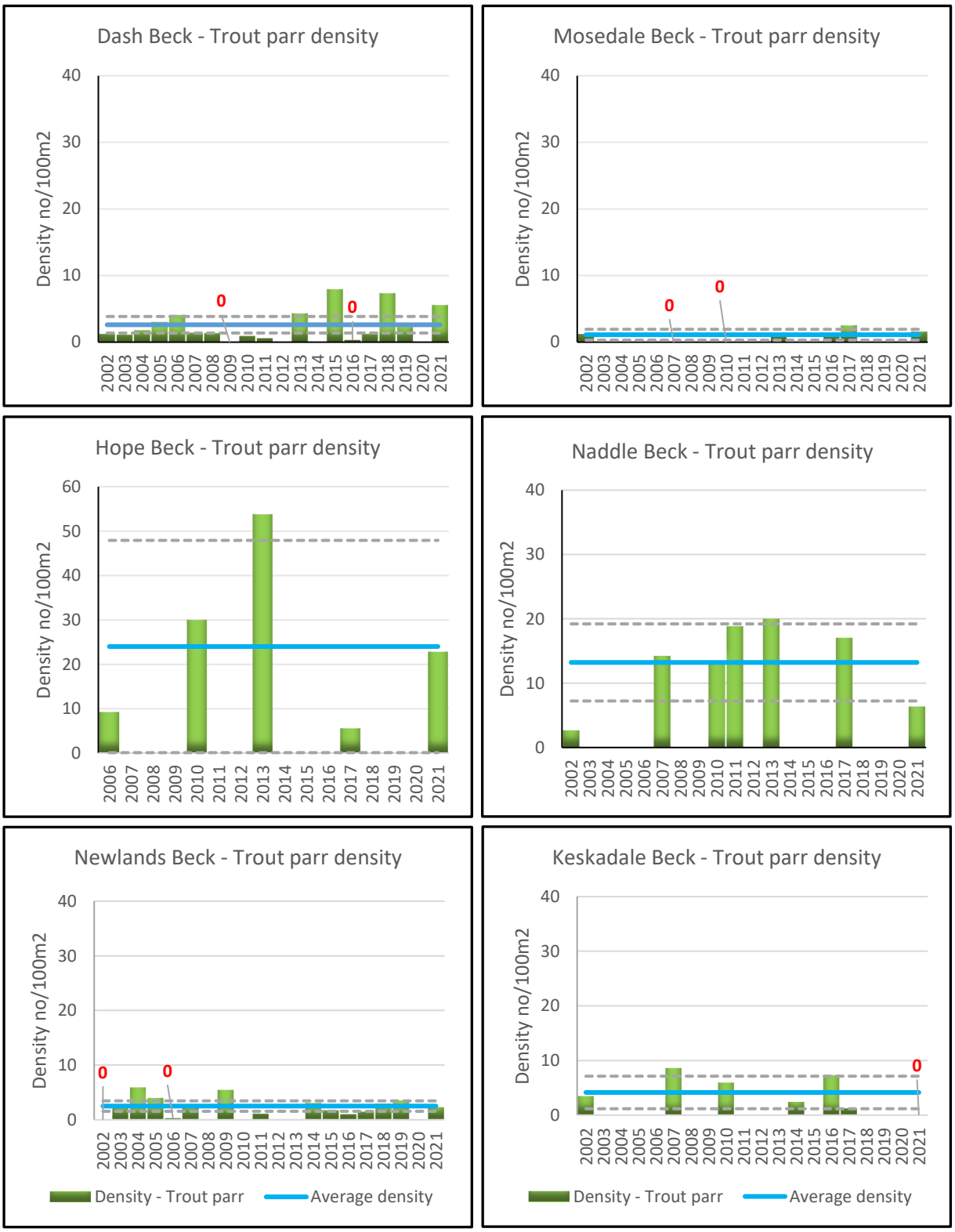
Figure 3.9 displays the most recent sea trout stock assessments across Cumbria and Lancashire. This relates to 2020 and places the Derwent sea trout in the Probably not at risk category.

Cumbria & Lancashire	Ribble	Probably at risk
	Lune	Probably not at risk
	Kent	Probably at risk
	Leven	Probably at risk
	Duddon	Probably Not at risk
	Esk (Cumbrian)	Probably at risk
	Irt	Not at risk
	Ehen	Not at risk
	Derwent	Probably Not at risk
	Ellen	Probably at risk
	Eden	Not at risk
	Esk (Border)	Probably Not at risk

Figure 3.9: Sea trout stock assessment categories for Cumbria & Lancashire rivers

3.5 Juvenile trout monitoring

Figure 3.10 below displays trout parr densities at 12 key sites across the Derwent catchment. These are the same sites displayed in section 2 above in the context of salmon, but with the addition of a further site (Hope Beck) which was omitted from section 2 on the grounds that it was not representative of typical, accessible salmon habitat. Trout fry densities for the sites are displayed in appendix 2, along with a map showing site locations.


Dash Beck - Trout parr density
Density no/100m2
Mosedale Beck - Trout parr density
Density no/100m2
Hope Beck - Trout parr density
Density no/100m2
Naddle Beck - Trout parr density
Density no/100m2
Newlands Beck - Trout parr density
Density no/100m2
Keskadale Beck - Trout parr density
Density no/100m2
Density - Trout parr
Average density

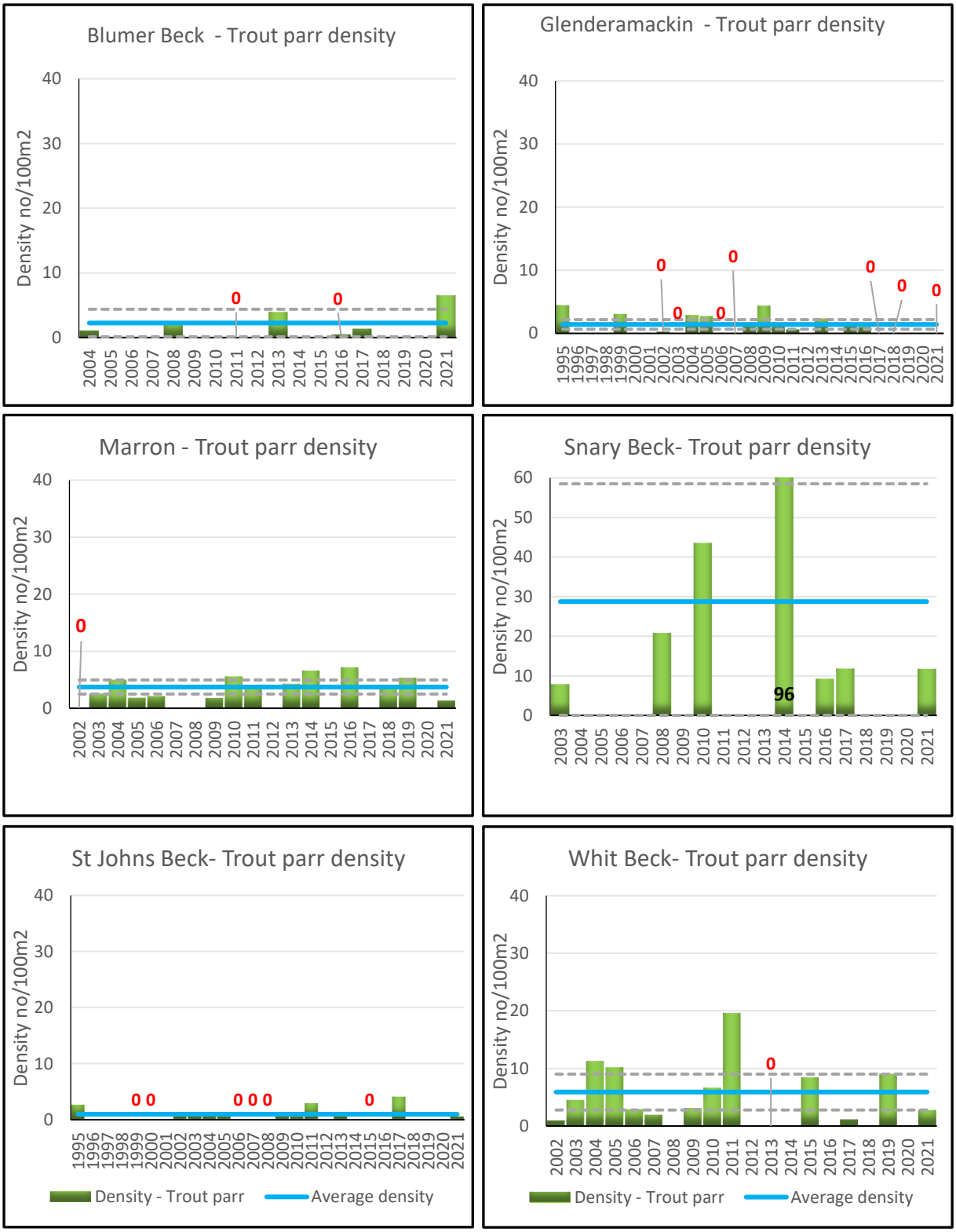


Figure 3.10: Trout parr densities at 12 regular Derwent catchment electro-fishing sites, including site average density (blue line) and 95% confidence limits (dashed grey lines). These sites were surveyed on five or more occasions since the mid 1990's.

Note: Surveys that yielded no fish are labelled with a **'0'**. The data reflects that which is available. Some sites have been surveyed more frequently than others. The average line reflects the average density at that site specifically.

Derwent catchment trout parr densities display a mixed pattern. Generally, trout parr densities are quite low across the sites surveyed. There are some notable exceptions, with high parr densities at sites such as Hope Beck and Snary Beck. While the St John's Beck site produces relatively high densities of salmon, it produces only very low densities of trout.

Trout fry densities (Appendix 2) do show more of a pattern. At most sites, trout fry densities have improved in more recent surveys. Unlike salmon fry, where some recent improvements are still below historic site performances, contemporary improvement in trout fry densities generally represent the highest densities in the entire time series.

At this time, we have no formal methodology for estimating sea trout egg deposition. We are therefore unable to undertake the same level of analysis as that set out for salmon, in terms of the relationship between adult sea trout stock in a given year, and consequent juvenile densities.

External sources of data

As per section 2, it is relevant to consider the data produced by West Cumbria Rivers Trust with regard to their annual programme of Derwent catchment salmonid fry monitoring.

The most recent WCRT report shows a general improvement in trout fry numbers captured since 2015, with a fairly consistent average showing for the last four years of surveying. Again, it is important to consider that these data relate to a shorter and more frequently surveyed time series than Environment Agency monitoring. For example, WCRT were able to deliver a survey programme in 2020, whereas no Environment Agency surveys took place that year. However, a general improvement and level performance in trout fry numbers in recent survey years by WCRT is consistent with generally better performance in trout fry densities shown at the 12 Environment Agency sites in more recent years.

Overall, Derwent catchment juvenile trout monitoring data shows a varied picture. Parr densities indicate a mixture of site performance. There are some consistently low levels, probably attributable to low habitat suitability for trout parr, or dominance by salmon spawning. There are also some signs of decline in recent years, and some of improvement.

Fry densities at most sites demonstrate a pattern of improvement and above site average performance in most recent survey years. This pattern is broadly contradictory to that exhibited by salmon fry densities over the same period.

4. Fisheries management options

4.1 Salmon

As identified in Section 2.4 above, the most recent salmon stock assessment categorises the Derwent salmon stock as At Risk, and declining. There is lower than 5% probability that stock will exceed the conservation limit in four out of five years. As such, our decision structure directs us to **"Identify a range of options to urgently achieve zero exploitation by both rods and nets (including 100% catch and release), looking to maintain socio-economic benefits where possible"**.

We have also considered, alongside Natural England, the SAC designation of the River Derwent and its current unfavourable condition due to the status of salmon stocks. We have an obligation to restore this condition status, where possible, to favourable.

We stress that the fishery itself is not likely to have caused the decline in the Derwent salmon stock to present levels. However, given the state of Derwent salmon stocks, it is now proportionate and necessary to protect the maximum number of salmon possible, and maximise spawning escapement. Each adult salmon is now crucial. Protecting the productive capacity of the salmon stock is our priority in our consideration of fisheries management options. The option of allowing the current byelaw to expire and not be replaced by any equivalent or stronger restrictions is not considered in detail.

Salmon fishery management options

Option 1: No change – maintain/renew current salmon fishing restrictions for the Derwent rod fishery (2 salmon per day bag limit & release all females in October)

Advantages	Disadvantages
For salmon stock: None. **For rod fishery:** No change in current angler behaviour or tackle required. Allowance for some salmon to be killed is likely to be more satisfactory to some anglers than further mandatory restrictions.	**For salmon stock:** No reduction in exploitation, and thus provides no gain for salmon stock. Risk of false reporting may increase (i.e. of killed fish being reported as released), may give a false impression of stock health. **For rod fishery:** Potential for friction between anglers/clubs where some anglers/clubs may continue to voluntarily release all salmon, whereas others may choose not to (still adhering to byelaw).
Option not taken forward because: **Not consistent with decision structure for At Risk stocks, requirements for improvement of unfavourable SAC condition status or NASCO guidance.** **Derwent salmon stock has no harvestable surplus. Every fish is crucial. Even low-level exploitation will at best delay, or at worst prevent recovery.**	

Option 2: Reduce the current kill of salmon through increased voluntary options such as:

- Increased voluntary catch and release
- and/or voluntary angling method restrictions.

Advantages	Disadvantages
For salmon stock: If there were further voluntary uptake of C&R practice by anglers who still currently kill salmon, this could improve spawning escapement. Some reduction in post-release mortality, and thus gain in spawning escapement, if method restrictions were widely adopted voluntarily. **For rod fishery:** Only minor change in current angler behaviour and/or tackle required for majority of anglers if they choose to adopt voluntary restrictions A voluntary approach to catch and release and method restrictions is likely to be more satisfactory to some anglers than mandatory controls.	**For salmon stock:** The Derwent Owners Association enacted a 100% voluntary C&R policy in autumn 2018. This has now been promoted for three full seasons, and whilst most anglers appear to comply with this, some do not. An average of approximately 10% of rod caught salmon have still been killed each season since 2018. Catch and release rates were 93%, 89%, 89% and 91% from 2018 – 2021 respectively. A continued voluntary policy therefore does not guarantee the required reduction of exploitation to zero. Some anglers will still choose to kill salmon despite a voluntary 100% release policy which has been in place for some time. Risk of false reporting may increase (i.e. of killed fish being reported as released), may give a false impression of stock health. **For rod fishery:** Potential for friction between anglers/clubs where some anglers/clubs may continue to voluntarily release all salmon, whereas others may choose not to.
Option not taken forward because: **Not consistent with decision structure for At Risk stocks, requirements for improvement of unfavourable SAC condition status or NASCO guidance.** **Derwent salmon stock has no harvestable surplus. Every fish is crucial. Even low-level exploitation will at best delay, or at worst prevent recovery.**	

Option 3: Reduce the current kill of salmon through <u>limited</u> mandatory options such as:

- Increased mandatory catch and release periods. For example, Derwent Owners Association suggested prohibiting <u>all</u> salmon kill during October (not just females as is the current regulation).
- A lower bag limit for salmon (e.g. 1 salmon per angler per season).

Advantages	**Disadvantages**
For salmon stock: Partial reduction in direct exploitation, and thus gain in spawning escapement possible if mandatory catch and release period is extended by 1 or even 2 months. **For rod fishery:** Only minor change in current angler behaviour required for majority of anglers. Continued voluntary approach to catch and release for part of the season may be more satisfactory to some anglers than mandatory controls.	**For salmon stock:** Increasing the mandatory catch and release period by 1 month would protect only limited numbers of salmon. For example, in 2021 an October ban on killing all salmon would have saved four out of 11 fish, and in 2020, 11 out of 37 fish (figure 2.9). This is not adequate protection. Furthermore, some anglers may deliberately kill more fish in other months. A seasonal bag limit of even just one fish per angler would protect only a limited number of salmon, because most anglers who kill a salmon only kill one fish (figure 2.8). For example, in 2021 such a limit would have protected only three out of 11 fish killed that year. Crucially, defining such a bag limit for 200-300 anglers would create a false impression of a sustainable level of take and potentially increase exploitation beyond current levels. Risk of false reporting may increase (i.e. of killed fish being reported as released), may give a false impression of stock health. **For rod fishery:** Additional regulation may not be well received by some anglers, and some may consider not fishing. Potential for inconsistency across angling clubs/groups/individuals. Some anglers may voluntarily release all salmon, whereas others may not.
Option not taken forward because: **Not consistent with decision structure for At Risk stocks, requirements for improvement of unfavourable SAC condition status or NASCO guidance.** **Derwent salmon stock has no harvestable surplus. Every fish is crucial. Even low-level exploitation will at best delay, or at worst prevent recovery.**	

Option 4: Byelaw requiring the mandatory release of all salmon for the full season, alongside an encouraged voluntary approach to method restrictions

Advantages	Disadvantages
For salmon stock: Maximum and enforceable protection from direct fishery exploitation, and thus maximum gain in spawning escapement. Dependant on uptake of voluntary method/tackle restrictions, there will be some reduction in post-release mortality, and thus some additional gain in spawning escapement. **For rod fishery:** The vast majority of Derwent anglers release all the salmon they catch. Over 80% of anglers who've caught salmon since 2018 have released all of them. So mandatory catch and release will have no impact on their angling. Clear, unambiguous, and enforceable regulations with regard to fish retention will rule out any perceived unfairness between different angling groups with regards to differing levels of voluntary restraint. Voluntary method restrictions would allow anglers to alter tackle/cease fishing with certain methods in a self-regulated manner without formal requirements.	**For salmon stock:** No disadvantage over current scenario in terms of direct exploitation. No guaranteed improvement in post-release mortality because voluntary method restrictions may not be widely adopted. Best practice catch and release guidelines have been poorly adopted by the angling community over the last 20+ years. **For rod fishery:** Formal regulation removing voluntary control and the ability to take salmon may be dissatisfactory to some anglers, and some may consider not fishing. Potential for inconsistency across angling clubs/groups/individuals in terms of voluntary method restrictions. Some anglers may comply with these, and others may not. Some anglers may not wish to alter their tackle/methods voluntarily. If a fish dies because of angling, it cannot be retained.
Option considered further alongside option 5 **Not fully consistent with decision structure guidance for At Risk stocks, or requirements for improvement of unfavourable SAC condition status and NASCO guidance.**	

Option 5: Byelaw requiring the mandatory release of all salmon, and method restrictions/tackle requirements including:

- Barbless or de-barbed hooks only
- Size and number limits on hooks that can be used (see section 5)
- Prohibit the use of natural baits

Advantages	Disadvantages
For salmon stock Maximum and enforceable protection for Derwent salmon from direct fishery exploitation, and thus maximum gain in spawning escapement. Additional stock protection and gain in spawning escapement through reduction of post-release mortality from restrictions on use of less fish friendly methods/tackle (Cowx et al 2017). **For rod fishery:** Over 80% of Derwent anglers who've caught salmon since 2018 have released all of them. So mandatory catch and release will have no impact on the majority. Method restrictions are likely to only result in relatively minor tackle alterations (hooks) for most and impact a small number of anglers with regards to prohibition of bait fishing. Clear and unambiguous regulation will rule out perceived unfairness between different angling groups with regards to differing levels of voluntary restraint. Consistency with other rod fishery regulation and method restrictions nationally for rivers with similar salmon stocks. Best opportunity for the rod fishery to contribute as much as possible to the protection and recovery of Derwent salmon stocks, whilst remaining open.	**For salmon stock:** No disadvantage over current scenario in terms of direct exploitation or catch and release mortality. **For rod fishery:** Formal regulation removing voluntary control and the ability to take salmon may be dissatisfactory to some anglers, and some may consider not fishing Tackle alterations and method restrictions will require some small-scale change and may impact those anglers who's preferred method is prohibited. If a fish accidentally dies because of angling, it cannot be retained.
Proposed option **Consistent with decision structure for At Risk stocks, requirements for improvement of unfavourable SAC condition status and NASCO guidance.** **Derwent salmon stock has no harvestable surplus. Every fish is crucial. This option delivers maximum achievable benefit from rod fishery.**	

Salmon fishery management - proposed option

Given:

- The current At Risk status of the Derwent salmon stock (Section 2.4)
- Our decision structure guidance, NASCO guiding principles and the precautionary approach, directing us to urgently reduce exploitation (Section 1 and Appendix 1)
- The unfavourable status of the Derwent SAC and the requirement to maintain/restore it to favourable status (Section 2.4)
- A general downward trend in most (but not all) juvenile densities, with monitored sites now generally falling below site averages. Combined with analysis indicating that lower egg deposition levels in recent years are deriving lower average densities of fry and parr (Section 2.5 and Appendix 2)

We propose that **option 5** as set above, is the most appropriate salmon management option at this time.

This option affords the maximum protection to salmon within the rod fishery and thus the greatest opportunity to enhance spawning escapement. This is urgently required given the key aspects set out above. Every spawning salmon is now crucial, and there is currently no harvestable surplus. It is not proportionate to the state of Derwent salmon stocks to allow any level of direct exploitation. The option maintains angling opportunity within the fishery, and the socio-economic benefits of it (see section 5).

4.2 Sea trout

The most recent basic Derwent sea trout stock assessment places the stock in the Probably Not At Risk category. Sea trout rod catch and juvenile trout data does not present the same pressing case for stricter stock management as that of salmon. This said, it is important that sea trout exploitation is managed such that exploitation does not increase disproportionately and cause a decline into higher risk categories. Sea trout stock must also be managed in a way which complements the proposed salmon fishery management option proposed above.

Sea trout fishery management

Option 1: No change – maintain/renew the current sea trout fishing restrictions

Advantages	Disadvantages
For sea trout stock If voluntary measures are sustained and remain consistent with recent seasons, stock protection level is high. For example, 100% of sea trout were released in 2020. **For rod fishery:** No change to current sea trout angling behaviour. Continued voluntary management approach.	**For sea trout stock:** No guarantee under voluntary measures that exploitation won't increase. No additional protection provided beyond current measures. **For rod fishery:** Potential for inconsistency across angling clubs/groups/individuals. Some anglers may continue to voluntarily release all sea trout, whereas others may not. If proposed salmon management option 5 is implemented, and sea trout option 1 were implemented for sea trout, there is a risk that anglers may feel uncomfortable using methods for sea trout that would not be permissible for salmon, given the risk of by-catch and potential mortality of salmon (i.e. by worm fishing, or spinning with barbed/treble hooks).
Option considered further	

Option 2: Introduce mandatory restrictions such as:

- bag limit, or mandatory release of sea trout

Advantages	Disadvantages
For sea trout stock Provides either partial, or maximum extra enforceable protection to Derwent sea trout stock from direct exploitation. Maximum protection against future deterioration and potential increase in sea trout exploitation because of proposed salmon management options. **For rod fishery:** The vast majority of Derwent anglers release all the sea trout they catch, so mandatory catch and release will have little to no impact on their angling.	**For sea trout stock:** No disadvantages compared to current measures. **For rod fishery:** Some anglers will find mandatory regulations dissatisfactory. Mandatory restrictions may not be proportionate to the current status of Derwent sea trout stock.
Option not taken forward because: - We do not believe mandatory controls on sea trout retention are required at this time.	

Option 3: Maintain voluntary approach and introduce angling method restrictions consistent with salmon management option 5.

Advantages	Disadvantages
For sea trout stock Provides some extra protection to sea trout stock through reduction of use of less fish friendly tackle/methods. **For rod fishery:** Continued voluntary management of catch and release Creates consistency across the proposed sea trout and salmon fishery management options in terms of methods and tackle and prevents risk of salmon by-catch on a method which would not be permissible for salmon under our proposed management option.	**For sea trout stock:** No disadvantages compared to current measures. **For rod fishery:** Some anglers will find mandatory method/tackle restrictions regulations dissatisfactory. Though tackle alterations will be minor, and method restrictions will impact a very small minority of anglers who catch sea trout on bait.
Proposed option	

Sea trout fishery management - proposed option

Given:

- The Probably Not At Risk status of the Derwent sea trout stock (Section 3.4)
- Rod catch data, indicating a relatively stable trend (section 3.2 and 3.3)
- Juvenile data, in particular fry densities, indicating improvement relative to whole time series (Appendix 2)
- The need to ensure sea trout fishery restrictions complement, and do not compromise, proposed salmon management options

We propose that **option 3** as set out above is the most appropriate sea trout management option.

This option allows the retention of sea trout, managed on a voluntary basis. We would encourage that this be formally administered by angling interests, and that existing high levels of catch and release are preserved. This option provides a layer of protection to the sea trout stock through mandatory method restrictions and does not undermine our preferred salmon management option. We believe this option is currently proportionate to the state of Derwent sea trout stocks.

5. Proposed Derwent rod fishery management options summary

In summary, our proposed Derwent rod fishery byelaws would require:

- **All salmon caught to be released unharmed and without undue delay.**
- **All hooks used within the rod fishery to be barbless or de-barbed.**
- **Fishing by means of bait, such as worms, to be prohibited.**

Specific detail on method restrictions would be:

- **All artificial lures must be fished with single barbless or de-barbed hooks only, which must not exceed 13mm in gape**

- All spinner/spoon type of lures (e.g., Flying Cs, Tobys, Devons) must be fitted with one barbless/de-barbed single hook only.

- Plug type lures can be fitted with a maximum of three single hooks

- **All artificial flies must be fished with barbless or de-barbed hooks only, and:**

- Treble hooks must not exceed 7mm in gape

- The gape of any single or double hook must not exceed 13mm

- A maximum of 4 hook points per fly is permissible

- **The use of natural baits (i.e., worms/shrimp/prawn) is prohibited**

Restrictions on the rod fishery as set out above will not, on their own, fully address declines in salmon abundance, or prevent potential sea trout stock deterioration. The Environment Agency is committed to delivering work in other areas, including, improving marine survival, reducing other forms of exploitation, safeguarding sufficient flows, removing barriers to migration and enhancing habitat, and maximising spawning success by improving water quality.

We acknowledge that the proposals would necessitate some change in angler behaviour and practice, though this is likely to be minimal given the evidence around current angler behaviour. We believe the proposals are necessary and proportionate to the present status of Derwent salmon and sea trout stocks.

6. Benefits and impacts

Our primary objective for the management of salmon fisheries is **to ensure the conservation or restoration of the salmon stock**. However, when new fisheries management measures are considered, socio-economic factors may be taken into account.

6.1 Benefits

Salmon

Derwent salmon stock is 'At Risk' of failing to meet the Management Objective in five years' time. There is no sustainable harvestable surplus. We must therefore urgently reduce exploitation to zero, such that the maximum number of adult fish survive to spawn and can contribute to recovering stocks. The key benefit of proposed measures here is that additional adult salmon would be available to spawn.

Since autumn 2018, the Derwent Owners Association have promoted voluntary 100% catch and release. However, some anglers have still chosen to kill salmon. Additional salmon will also have died before spawning, due to post release mortality associated with injury and/or stress from capture. Our proposed measures would prohibit any direct kill of salmon within the fishery and increase survival of salmon that were caught and released.

Table 2 below details average seasonal losses of salmon due to direct kill by anglers within the Derwent rod fishery from 2019-2021 and estimated average seasonal losses due to post-release mortality, based on a range of possible mortality rates. It is important to note that post release mortality is difficult to quantify exactly and is dependent upon many factors such as fishing method and tackle, handling practice, and water temperature. Our proposed method and tackle restrictions are reasonably expected to reduce catch and release mortality by targeting key aspects which are known to lead to injury and stress.

Table 2: Average salmon losses from angler kill and estimates of post-release mortality 2019-2021

2019-2021 average rod catch (corrected)[4]	Salmon killed by anglers per season (corrected)[4]	20% mortality post release per season	15% mortality post release per season	10% mortality post release per season	5% mortality post release per season
241	**25**	**48**	**36**	**24**	**12**

As table 2 sets out, a corrected average of 25 salmon per season have been killed within the Derwent rod fishery between 2019 and 2021. Our proposed measures would prohibit such kill of salmon, and these fish would therefore be immediately added to spawning escapement. Post release mortality will also have occurred over this period, and table 2 provides four possible estimates of fish losses per season over this time. These estimates are based on the 20% figure used in annual stock assessments, and three other better case scenarios.

[4] This correction refers to the raising factor of 1.1 applied to overall salmon rod catch during annual salmon stock assessments, to account for anglers who do not report their catch.

Using a simple average fecundity of 5600[5] eggs per salmon, there was an approximate average deficit of 347 hen salmon for the most recent three Derwent conservation limit failures. This deficit is clearly more than the total numbers of fish killed within the rod fishery, and those likely to have died post release. However, proposed measures would immediately increase the number of salmon that survive to spawn, and thus contribute to reducing this deficit. This would contribute positively to recovering stocks, and forms one necessary part of the jigsaw, alongside other actions.

We recognise that proposed measures will not on their own, make up deficits in spawning. We do not believe that the rod fishery is the cause of recent declines. However, proposed measures would immediately add spawning salmon to an 'At Risk' river. At present, allowing any salmon to continue to be lawfully killed is wholly disproportionate and unsustainable, and will at best delay, or at worst prevent recovery of the stock.

Sea Trout

Measures proposed for sea trout would lead to improvements in post-capture survival, whilst maintaining a voluntary approach to their retention. The measures would complement those proposed for salmon. We believe our proposed sea trout management option will allow sea trout stocks to maintain or improve on their current levels.

The Derwent sea trout stock will be afforded some protection through proposed method restrictions. Sea trout stocks are such that we do not believe mandatory retention restrictions are currently required, provided anglers continued to ensure voluntary catch and release rates remain at or near current high levels.

6.2 Impacts – economic and social

It is important to consider and assess both the economic and social impacts of proposed measures on the Derwent rod fishery. These must be considered against the backdrop of other existing variables within the fishery, such as rod catch, and changing behaviour of anglers over time.

In order to make a judgement of the potential financial impact, it has been necessary to try to establish a value for the Derwent rod fishery. This value is not exact, nor is its specific amount pivotal to consideration here. The key aspect is the relative impacts on the value that may occur as result of variables such as the proposed measures and possible resultant changes in angler effort and associated catch. Data to value the sea trout fishery are not available, so the economic impacts focus primarily on salmon, and specifically how mandatory catch and release may impact salmon fishery value.

The following calculations (summarised in table 2) attempt to estimate the **Nett Economic Value** of the river Derwent salmon fishery, defined by summing the following components:

- Value to fishery owners (calculated by estimating the market value of fishing rights).
- Value to salmon anglers (calculated by estimating the consumers' [anglers'] surplus).

[5] Based on a simple mean fecundity (multi sea winter + grisle /2). The precise average fecundity will vary year on year with the proportions of grisle and multi sea winter fish in the run.

Market value of the fishing rights

Although inherently variable across both spatial and temporal scales, market value of salmon fishing rights in a given year can be generally defined as a function of the five-year average rod catch preceding that year, multiplied by the value per salmon caught (Radford *et al* 2001). The five-year average rod catch is deemed most appropriate, because it eliminates some of the annual variation in rod catch. A raising factor of 1.1 is applied to declared rod catch (consistent with our national approach to egg deposition and stock assessment), to account for the fact that a proportion of anglers fail to declare what they catch.

The value per salmon caught is variable, and there is no simple method for ascertaining this value at a given point. However, Radford *et al* (1991) detail survey work undertaken nationally to derive a monetary value per salmon. This was produced as a function of overall values of the fishing rights on a river, combined with associated salmon catch. Further work by Radford *et al* in 2001 provides a value per salmon for North-West rivers as £8,400. Using the Bank of England inflation calculator, this value would equate to **£14,783** in 2021.

Anglers' Consumers Surplus – the value of a fishery to anglers

This term describes a means by which an economic valuation can be put upon the value of the fishery to anglers. This is essentially measure of the willingness of anglers to pay for their fishing. There has only been one study to calculate the consumers' surplus of salmon anglers (Radford, 1984). The techniques utilised in the assessment are complex. To simplify this, Radford (1984) attempted to make a comparison between the market value of the fishing rights and the anglers' consumer surplus for four salmon rivers throughout England and Wales. The resulting ratios obtained from this study varied widely. To ensure consistency on a national basis, the lowest ratio obtained (1:1) has been used as the basis for a conservative estimate of the capitalised anglers' consumers' surplus.

In conclusion, for the purposes of this report, the capitalised anglers' consumers' surplus, or willingness to pay is taken to be equivalent to the estimated market value of the fishing rights. The resultant calculations are shown in table 2 below.

Table 3: Derwent fishery value estimations

Mean declared Annual Derwent rod catch 2017-2021	Mean total Annual Derwent rod catch (corrected by 1.1) [6]	Mean Regional value per salmon (2021)	Market (capital) value to rod fishery	Angler's consumers surplus	Estimated fishery value
224	**247**	**£14,783**	**£3.65m**	**£3.65m**	**£7.30m**

Potential impact on fishery value

In 2018, National Salmon and Sea Trout byelaws were introduced. As part of the formulation of these, national angler surveys were undertaken in 2016/17 (Amec Foster Wheeler 2018). These surveys asked anglers how their behaviour might change under various different

[6] This correction refers to the raising factor of 1.1 applied to overall salmon rod catch during annual salmon stock assessments, to account for anglers who do not report their catch

regulatory scenarios. One scenario was that mandatory catch and release of salmon would be applied to At Risk rivers. Responses to this scenario are relevant here, as the Derwent salmon stock is now "At Risk" and we are proposing mandatory catch and release of salmon.

Survey results for this scenario showed that in the North-West, there could be a 22% reduction in angling effort (number of days fished) as a result of some anglers stopping fishing. By way of a worst case example, we could assume that such a 22% reduction in effort would lead to the same proportional decline in rod catch, and thus fishery value. Applying a reduction of 22% to 2021 corrected rod catch would lead to a reduction of around 30 salmon. This equates to a theoretical reduction in 2021 fishery market value of **£0.44 million**, and a corresponding amount for angler's consumer surplus.

The real loss in value is likely to be much less than this. This is because generally, most anglers do not catch any salmon (see section 2, figure 2.7). For example, in 2020 and 2021, 65% and 72% of anglers were unsuccessful. It is very likely therefore that a reduction in overall effort would not lead to the same proportional drop in overall rod catch.

To put these worst-case economic impacts of proposed fishery restrictions into context, it is important to consider how fishery value has already declined over time. For example, if the fishery were producing rod catches akin the five-year average from 2007-2011, then at present day values, it would be worth an estimated £37.60million. As it stands, far lower rod catch means the fishery is worth much less than this. **The largest threat to fishery value is likely to be declining salmon abundance, not fishery restrictions.**

Trip and Non-Trip Related Expenditure

It is possible to critique potential economic impacts of mandatory catch and release further, using estimated costs for trip related expenditure (TRE) and non-trip related expenditure (NTRE). TRE can be defined as expenditure directly related to that fishing trip. This might include aspects such as travel costs, day tickets, subsistence, or accommodation. NTRE covers wider costs that aren't specific to one trip. These may include things like club memberships, clothing, tackle, equipment, and literature.

Estimates of TRE & NTRE are provided in published survey evidence (Survey of Freshwater Angling in England Phase 1" (EA, 2018)). Combining these estimates with angler effort data and the results of the angler surveys described above, it is possible to calculate potential economic impacts from changes in TRE and NTRE as a result of proposed Derwent fishery management options. These are displayed in tables 3 and 4 below.

Table 3: Estimated reduction in trip related expenditure

Average fishing effort (days fished) 2017-2021	22% loss of effort (days fished) 2017-2021	Trip related expenditure (£ per day)	Estimated TRE reduction (£)
2745	**604**	**£54.26** [7]	**£32,770**

[7] Value taken from Survey of Freshwater Angling in England Phase 1 (EA, 2018) for North-West, and raised using Bank of England Calculator to 2021 value, from 2015 value of £46

Table 4: Estimated reduction in non-trip related expenditure

Average number anglers 2017-2021	22% loss in anglers (2017-2021)	Non-trip related expenditure (£ per day**)**	Estimated NTRE reduction (£)
251	**55**	**£1229.16** [8]	**£67,874**

Potential impact on angler participation/behaviour

In 2018, the Derwent Owners Association introduced a voluntary 100% catch and release policy for salmon. According to rod catch data, since then most Derwent anglers appear to be complying with this policy. Relatively few anglers now kill Derwent salmon. For context, 6 out of 48 successful anglers killed salmon in 2018, 13 out of 76 killed salmon in 2019, 16 out of 90 killed salmon in 2020 and 8 out of 52 killed salmon in 2021.

Over 80% of anglers who've caught salmon each season since 2018, have released all of them. Mandatory catch and release would therefore require no change in behaviour for the vast majority of Derwent salmon anglers.

Some anglers, particularly those still killing salmon, might choose to leave the fishery or make less fishing effort under mandatory catch and release requirements. As referenced above, the 2016/17 survey indicates a potential loss of 22% of angling effort under a scenario that emulates that proposed for the Derwent here.

Proposed method restrictions for both salmon and sea trout are unlikely to impact angler participation significantly, though it is recognised that they may require adaptation of tackle (e.g., changing of hooks, or crushing of barbs). Perhaps the largest change and impact upon angling, is that anglers who bait fish, will no longer be able to use this method. Referring to section 2.3 above, bait fishing accounts for a very small percentage of rod catch. It is therefore likely that this change will impact a correspondingly low number of anglers.

During informal consultations, the option of formulating proposed byelaws to retain the use of shrimp or prawn baits was suggested to stakeholders. We considered this a possibility due to low levels of fish mortality associated with this method, and the potential opportunity to present some extra level of fishery accessibility and minimise impacts on anglers. However, there was no meaningful support for this option, with the overriding sentiment being that most fishery clubs or beats prohibit the use of shrimp/prawn within their own rules.

In summary, regardless of proposed new restrictions, Derwent angling effort and angler participation has declined substantially in recent years. This is likely to be a direct result of the concurrent decline in adult salmon abundance. Improving salmon numbers is likely to be the key to improving angling participation.

[8] Value taken from Survey of Freshwater Angling in England Phase 1 (EA, 2018) and raised using Bank of England Calculator to 2021 value, from 2015 value of £1042

Evidence from other areas

Since 2018, the rivers Eden and Border Esk fisheries have been required to release all salmon caught. Figure 5.1 shows angling effort on both catchments, along with the Derwent, and the nearby River Ehen for reference.

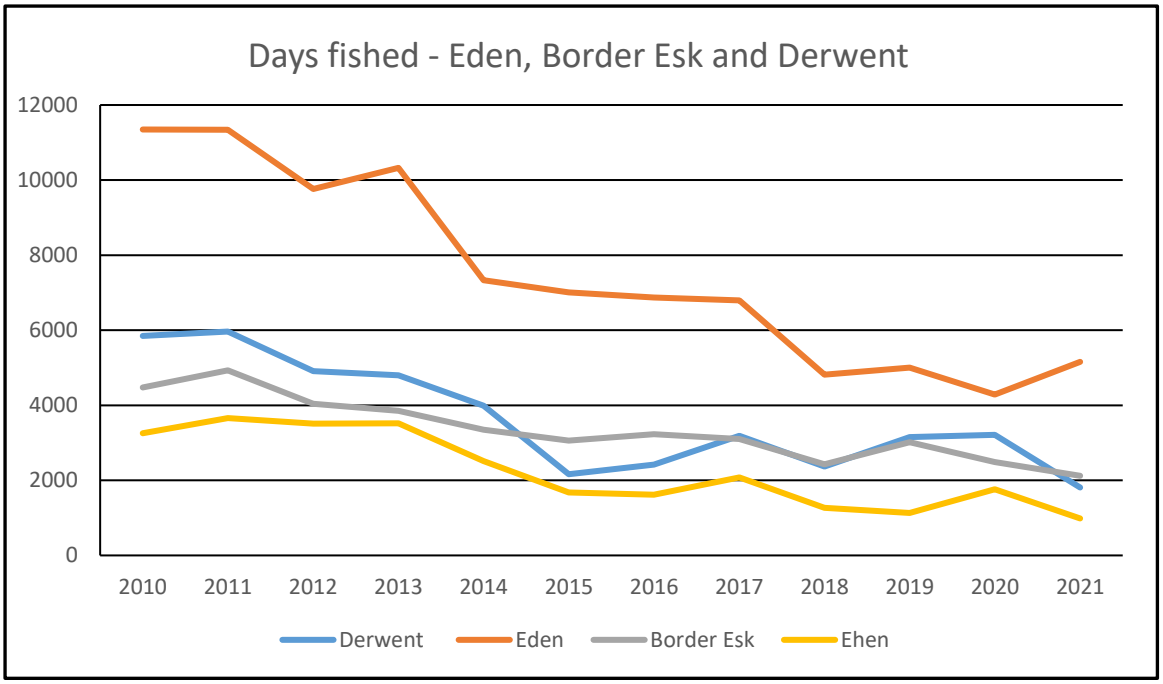


Figure 5.1: Number of days fished on Rivers Eden, Derwent and Border Esk 2010-2021

In figure 5.1, the decline in angling effort from 2017 to 2018 on the Eden and Border Esk could be explained by anglers leaving the fishery as a result of new restrictions that came into force in 2018. There was a 29% and 21% reduction in effort on the Eden and Border Esk respectively between 2017 and 2018. This is relatively closely aligned to the 22% suggested in North-West survey responses discussed above. However, at the same time, a 26% decline in effort occurred on the Derwent, and a 39% decline occurred on the nearby Ehen. Neither river had any new restrictions. It is therefore likely that other factors, such as the prevailing dry weather conditions, could have caused this short-term decline. Similar year-to-year declines have occurred on all four catchments before, where no change in angling restrictions applied (i.e., the Eden and Ehen from 2013 to 2014)**.**

As well as specific year-to year decreases, there is an overall picture of decline in angling effort throughout the last decade on all four fisheries in figure 5.1. Much of this decline occurs prior to, or in the complete absence of mandatory catch and release. Whilst some year-on-year differences may well be associated with aspects such as dry weather, it is likely that the overall picture of declining effort is driven by reducing abundance of salmon, and the associated reduction in the appeal of these fisheries. This is a pattern which is consistent with other salmon rivers nationally and is concurrent with the background of a decline in salmon across much of its native range.

Since 2018, under mandatory catch and release requirements, angling effort has remained more stable on the Border Esk and Eden fisheries. Both fisheries saw an improvement in effort in 2019, and in the case of the Border Esk, angling effort has actually increased above what was expected based on the previous years of decline. Local discussions with fishery owners and club officials suggests that in some cases, clubs and fisheries on the Eden and

Esk are experiencing higher demand than previously, either being fully booked or having marked increases in permit sales.

It is very likely that for the majority of anglers, angling effort and participation is primarily driven by the perceived likelihood of catching salmon, not whether they can kill fish within their chosen fishery. Whilst some anglers may choose to leave a fishery as a result of mandatory catch and release, we believe the majority will remain whilst there are fish to catch. Of those that do leave, some may return, especially if salmon runs improve. New anglers may also join the sport if the opportunity to catch salmon improves.

A reduction in abundance of returning adult salmon is likely to be the overwhelming factor that devalues the Derwent salmon rod fishery and reduces angling participation and effort within it. Some anglers may choose to leave the fishery if proposed restrictions were imposed. The socio-economic impacts of this should be considered against the backdrop of pre-existing declines in salmon runs and in angling, and the fact that proposed measures will require little to no behavioural change for the majority of Derwent anglers.

It should also be considered that an improvement in salmon numbers, which these measures aim to help achieve, is likely to lead to anglers returning to the fishery. This may in turn have a corresponding positive socio-economic impact.

7. Conclusion

After conducting a review of stocks and relevant fisheries data, we believe that our proposed fishery management options, as set out in section 5, are proportionate and necessary to the current state of Derwent salmon and sea trout stocks.

Whilst our priority is the conservation and restoration of these stocks, we have considered the impacts of proposed measures on the Derwent rod fishery. We believe that our proposed measures provide the right balance. They aim to achieve the appropriate and required level of salmon and sea trout stock protection, whilst maintaining a rod fishery and aiming to enhance it through helping improve the fish stocks it depends upon.

The proposed measures are not designed to prevent angling, but to help preserve and restore salmon and sea trout stocks. The measures should not be viewed in isolation, but as one of a range of actions required to conserve and restore our salmon and sea trout stocks. They are only one part of a wider jigsaw, but a necessary and proportionate part, nonetheless. The Environment Agency is committed to continuing work with its partners within the Derwent catchment to improve marine survival, reduce other forms of exploitation, safeguard sufficient flows, remove barriers to migration, enhance habitat, and maximise spawning success by improving water quality.

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Appendices

Appendix 1: Salmon management procedures/developments in England and Wales

Conservation Limits (CLs) and Management Objectives

Setting conservation limits

The use of CLs in England and Wales has developed in line with the requirement of ICES and NASCO to set criteria against which to give advice on stock status and the need to manage and conserve individual river stocks. CLs indicate the minimum desirable spawning stock levels below which stocks should not be allowed to fall. The CL is set at a stock size 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.

Two relationships are required to derive the CLs:

(i) a **stock-recruitment curve** – defining, for the freshwater phase of the life cycle, the relationship between the number of eggs produced by spawning adults (stock) and the number of smolts resulting from those eggs (recruits).

(ii) a **replacement line** – converting the smolts emigrating from freshwater to surviving adults (or their egg equivalents) as they enter marine homewaters. This relationship requires an estimate of the survival rate at sea.

The model used to derive a stock-recruitment curve for each river assumes that juvenile production is at a 'pristine' level for that river type (i.e. is not affected by adverse water quality, degraded physical habitat, etc.).

Similarly, in deriving the replacement line, marine survival rates for most river stocks were assumed to be equivalent to the rates estimated on UK monitored rivers (such as the North Esk) in the 1960s and 1970s. Default survival values recommended for this purpose were 25% for 1SW salmon and 15% for MSW fish (Environment Agency, 1998). However, that period is thought to be one of high sea survival, and new default values of 11% for 1SW salmon and 5% for MSW fish, which are more representative of sea survival over the last 20-30 years, were introduced by the Environment Agency in April 2003 (Environment Agency, 2003b).

These rates have now been applied in calculating CLs for all the 64 principal salmon rivers. Since 2003, the CLs for all principal salmon rivers for which egg deposition estimates are assessed annually have incorporated the new lower marine survival estimates. The net effect of these changes was to reduce the CLs: the scale varied from river to river, but resulted in a 26% reduction, on average, in England and Wales from values used prior to 2003.

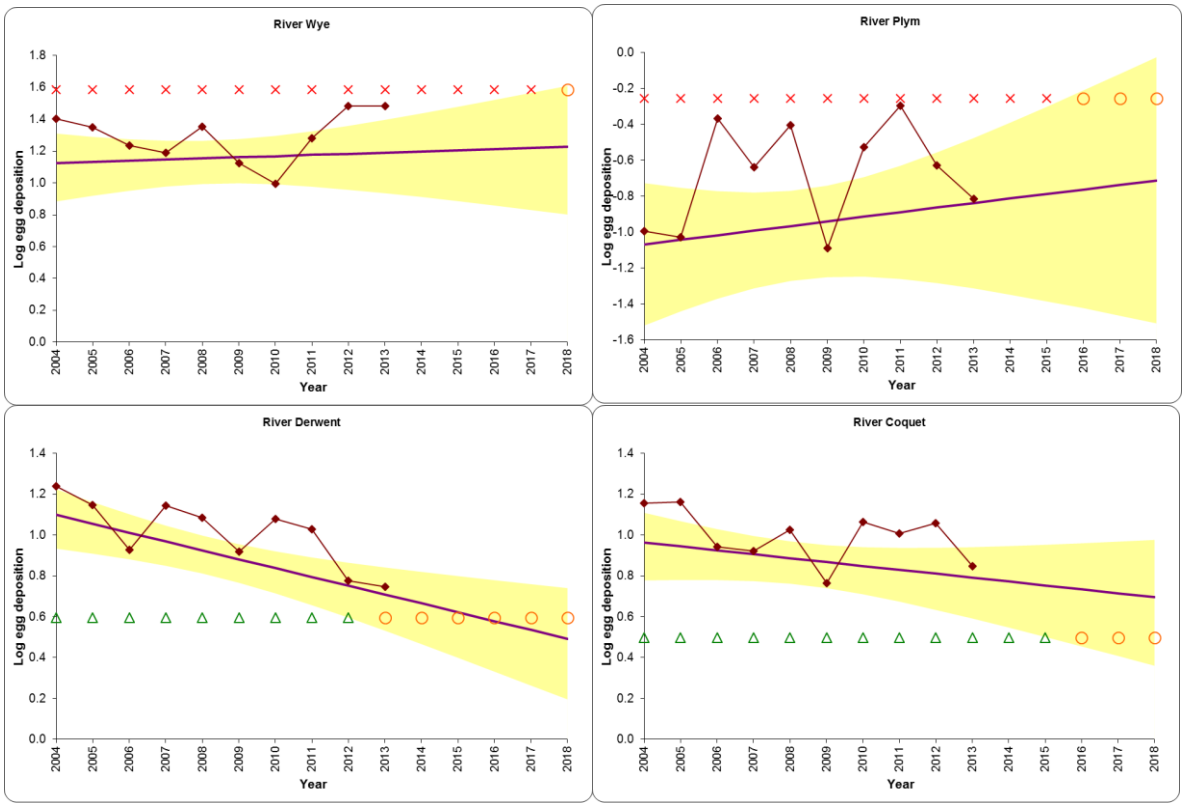
Introducing marine survival rates which are intended to be closer to those currently experienced by UK salmon stocks will reduce the effect of high mortality at sea as a cause of failing CLs. This will help managers focus on other issues over which they have more control (e.g. poor environmental quality in-river, over-exploitation by net and rod fisheries, etc.) when compliance failure occurs. The reduction in CLs means, however, that lower levels of spawning escapement are accepted before the stock is considered to be threatened. The

Environment Agency also uses the ‘management objective’ for each river (e.g. in reviewing management actions and regulations) that the stock should be meeting or exceeding its CL in at least four years out of five (i.e. at least 80% of the time). This management objective is built into statistical procedures for assessing compliance with CLs (below).

Compliance assessment

The performance of salmon stocks in England and Wales is assessed using a compliance scheme designed to give an early warning that a river has fallen below its CL. An approach introduced in 2004 provides a way of summarising the performance of a river’s salmon stock over the last 10 years (including the current year), in relation to its CL. Bayesian regression analyses are applied to egg deposition estimates from the last 10 years, on the assumption that there might be an underlying linear trend over the period. The method fits a 20-percentile regression line to the data and calculates the probability that this regression line is above the CL, and thus that the CL will be exceeded four years out of five (the management objective). If there is a low probability (<5%) that the 20-percentile regression line is above the CL, the river fails to comply (i.e. is regarded ‘at risk’). If the probability is high (>95%), the river complies in that year (i.e. is ‘not at risk’), whereas between these probability values we cannot be certain of the stock status (the river is assessed as either ‘probably at risk’ (5%< p <50%) or ‘probably not at risk’ (50%≤ p <95%). The results are in broad agreement with the compliance scheme used prior to 2004. The current scheme also allows the 20-percentile regression line to be extrapolated beyond the current year in order to project the likely future performance of the stock relative to its CL, and so assess the likely effect of recent management intervention and the need for additional measures.

The compliance plots for the Rivers Wye, Plym, Derwent and Coquet for the years 2004-2013 are shown below as examples. These include individual egg deposition estimates (black dots on the graphs) for these years, the 20 percentile regression lines and (shaded) 90% Bayesian Credible Intervals (BCIs), and the CL lines (represented by up to three symbols: X, O and Δ).



When the upper bound (95 percentile) of the regression line BCI is below the CL line, the river is judged to be failing its CL (i.e. there is a ≥95% probability of failure or the river is 'at risk'). For example, this is the case on the Wye from 2004 to 2017 and on the Plym from 2004 to 2015 and is indicated by the X symbol on the CL line. When the lower bound (5 percentile) of the regression line BCI is above the CL line the river is judged to be passing its CL (i.e. there is a ≤5% probability of failure and the river is 'not at risk'). This is the case on the Derwent from 2004 to 2011 and the Coquet from 2004 to 2014 and is indicated by the Δ symbol on the CL line. For all other years on these rivers, the shaded BCI of the regression line overlaps the CL line and so the status of the river is judged as 'uncertain' (i.e. the probability of failure is >5% but <95%, and the river is either 'probably at risk' or 'probably not at risk'). This is the case on the Derwent from 2012, the Coquet from 2015, the Wye from 2018 and on the Plym from 2016 and is indicated by the O symbol on the CL line.

Egg deposition estimates for a river may be consistently above the CL but status may still be uncertain. This is the case on the Coquet from 2015 and the Derwent from 2012 (O symbol on the CL line). In part, this reflects the marked year-to-year variation in egg deposition estimates on these rivers, which produces broad BCIs around the regression lines, but also arises because of the slope of the trend line and the increasing uncertainty associated with all regressions once extrapolated beyond the data set.

As well as providing an assessment of the status of a river in relation to its CL, the direction of the trend in the 10-year time-series of egg deposition estimates and its statistical significance may also serve as an important indicator of the need to take management action and of the degree of intervention required. Thus, a clear negative trend would give additional cause for concern.

The Management Target (MT) for each river is a spawning stock level for managers to aim at, to ensure that the objective of exceeding the CL is met four years out of five in the long run (i.e. 80% of the time). The value of the MT has been estimated using the standard deviation (SD) of egg deposition estimates for the last 10 years, where: MT = CL + 0.842*SD. The constant 0.842 is taken from probability tables for the standard normal distribution, such that the CL forms the 20-percentile of a distribution, the average (or 50-percentile) of which equates to the MT.

CLs and MTs form only one part of the assessment of the status of a stock, and management decisions are never based simply on a compliance result alone. Because stocks are naturally variable, the fact that a stock is currently exceeding its CL does not mean that there will be no need for any management action. Similarly, the fact that a stock may fall below its CL for a small proportion of the time may not mean there is a long-lasting problem. Thus, a range of other factors are taken into account, particularly the structure of the stock and any evidence concerning the status of particular stock components, such as tributary populations or age groups, based for example on patterns of run timing and the production of juveniles in the river sub-catchments. These data are provided by a programme of river catchment monitoring.

The assessment approach described above is incorporated into the national decision structure (see below) for guiding decisions on fishery regulations.

The Decision Structure for developing fishing controls in England and Wales

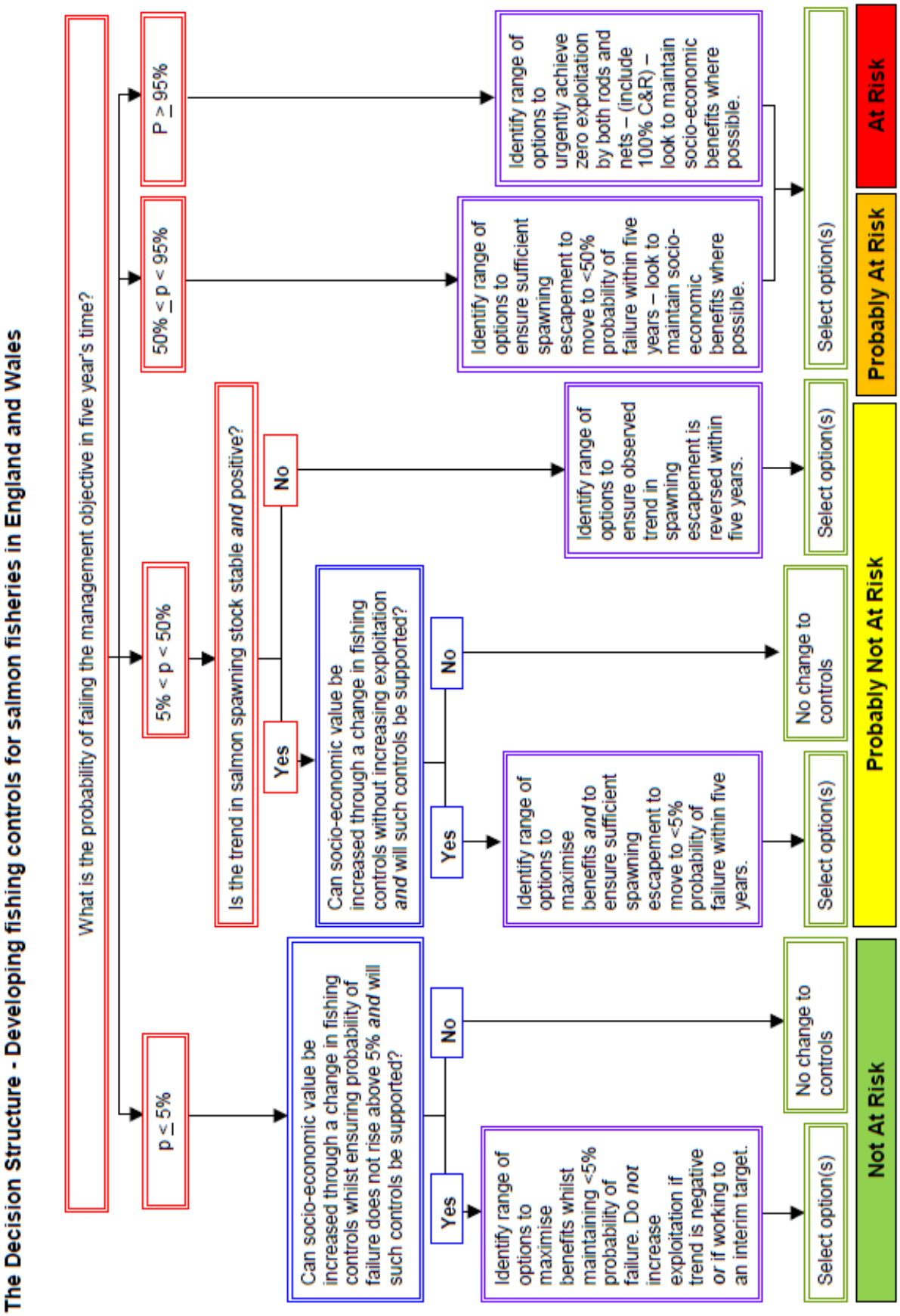
The compliance assessment approach described above for determining the performance of each salmon river is also incorporated into a national decision structure for guiding decisions

on the need for fishery regulations. The ‘Decision Structure’ is applied annually to each salmon river in April following the annual stock assessments. Fishery managers for each river are then advised of these assessments and the outcome of applying the ‘Decision Structure’. They then decide what, if any, changes in regulation are appropriate as guided by the Decision Structure outputs. Recovering rivers that do not yet have CLs set are deemed to be ‘at risk’ and, under new measures approved in 2018, all such rivers in England will be subject to mandatory C&R from 2019. Similar provisions will apply in Wales if measures are approved.

In 1998, NASCO and its Parties agreed to apply a Precautionary Approach to the conservation, management and exploitation of salmon in order to protect the resource and preserve the environments in which it lives. In keeping with this, the assessment and management of salmon in England and Wales seeks to avoid the possibility of stocks reaching unfavourable levels. The Precautionary Approach requires that more caution is exercised when scientific information is uncertain. Where there are threats of serious or irreversible damage to stocks, uncertainty in scientific information should not be used as a reason for postponing or failing to take management and conservation measures.

The methodology for assessing salmon stocks, and the associated compliance scheme and decision structure, are currently under review to consider the need for possible improvements. The aim is to undertake this within the next three years with the likelihood that improvements will be introduced in stages as developments allow.

The ‘Decision Structure’ is shown in the schematic flow chart below, together with explanatory notes for its use.


The Decision Structure - Developing fishing controls for salmon fisheries in England and Wales
What is the probability of failing the management objective in five year's time?
p ≤ 5%
5% < p < 50%
50% ≤ p < 95%
P ≥ 95%
Can socio-economic value be increased through a change in fishing controls whilst ensuring probability of failure does not rise above 5% and will such controls be supported?
Yes
No
Identify range of options to maximise benefits whilst maintaining <5% probability of failure. Do not increase exploitation if trend is negative or if working to an interim target.
No change to controls
Select option(s)
Not At Risk
Is the trend in salmon spawning stock stable and positive?
Yes
No
Can socio-economic value be increased through a change in fishing controls without increasing exploitation and will such controls be supported?
Yes
No
Identify range of options to maximise benefits and to ensure sufficient spawning escapement to move to <5% probability of failure within five years.
No change to controls
Select option(s)
Probably Not At Risk
Identify range of options to ensure observed trend in spawning escapement is reversed within five years.
Select option(s)
Identify range of options to ensure sufficient spawning escapement to move to <50% probability of failure within five years – look to maintain socio-economic benefits where possible.
Select option(s)
Probably At Risk
Identify range of options to urgently achieve zero exploitation by both rods and nets – (include 100% C&R) – look to maintain socio-economic benefits where possible.
Select option(s)
At Risk

Notes to accompany Decision Structure

1. Initial stage – stock assessment (red boxes)

This is the assessment of the probability that the salmon river will be meeting its CL four years out of five (the management objective) in five years' time. The information to answer these questions comes from the annual assessment process, with the latest results available in the most recent annual assessment report.

2. Second stage – initial screening for potential options (blue boxes)

This stage screens options appropriate to those rivers that have a **<50% probability of failing the management objective** taking into consideration socio-economic concerns and stakeholder support. Management options that would not be supported by stakeholders can be ruled out. One of the possible options is to 'do nothing'.

For rivers where there is **>50% probability of failing the management objective**, all options must be carried through to the next (evaluation) stage.

3. Third stage – option evaluation (purple boxes)

The purpose of this stage is to set out and evaluate options to realise the required changes in exploitation.

For rivers where 50% ≤ p <95% (where p = probability of failing the management objective) **and the trend is down** and with an annual catch of >20 salmon and C&R rate <90%, then voluntary catch and release (C&R) will be promoted for 1 year. If this fails to significantly improve C&R rates, mandatory C&R or closure of the fishery will be considered. Protected rivers such as SACs (Special Areas of Conservation) are given particular emphasis.

For rivers where the above criteria apply, except that the annual mean salmon catch is <20 salmon, voluntary measures will be promoted.

For rivers where p>95% (i.e. the management objective is clearly being failed) and with an annual catch of >20 salmon and a C&R rate <90%, then voluntary C&R will be promoted for 1 year. If this fails to significantly improve C&R, mandatory C&R or closure of the fishery will be considered.

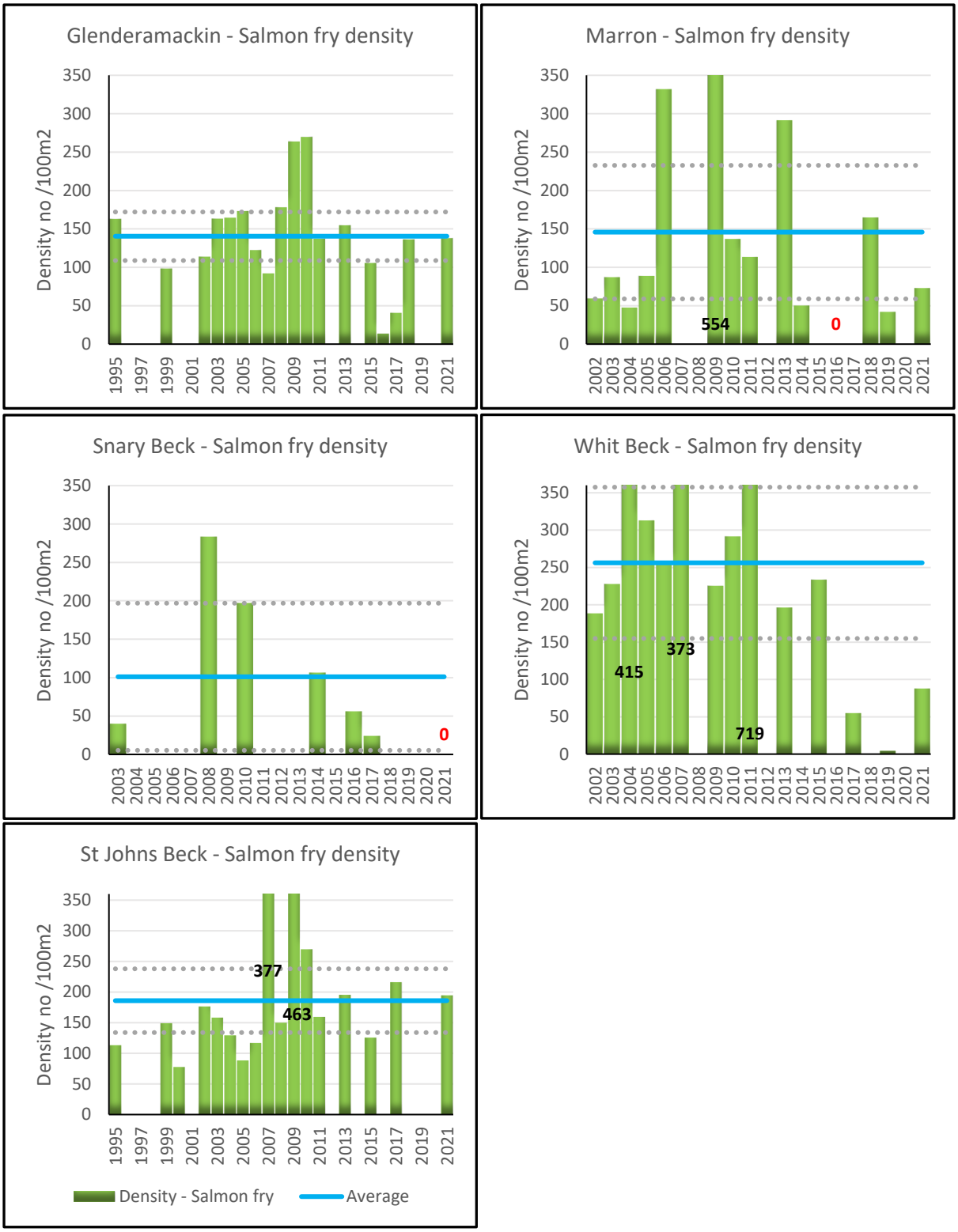
For rivers where p ≤ 95% for 5 consecutive years (i.e. the management objective is clearly being met), the possibility of relaxing controls including on nets will be considered if stakeholders agree.

Rivers that are recovering from historical degradation that do not yet have CLs set are deemed to have a >95% probability that they are failing unless there is better information available. Fishers on such rivers are encouraged to practice 100% C&R at the same time as regulators and partner organisations work on the necessary environmental improvements. If the potential for these rivers is greater than an average rod catch of 20 salmon, then mandatory C&R is considered throughout the season as an interim measure. However, controlled development of fisheries may be permitted on these rivers in parallel with the recovery of stocks.

4. Final stage – selection and implementation (green boxes)

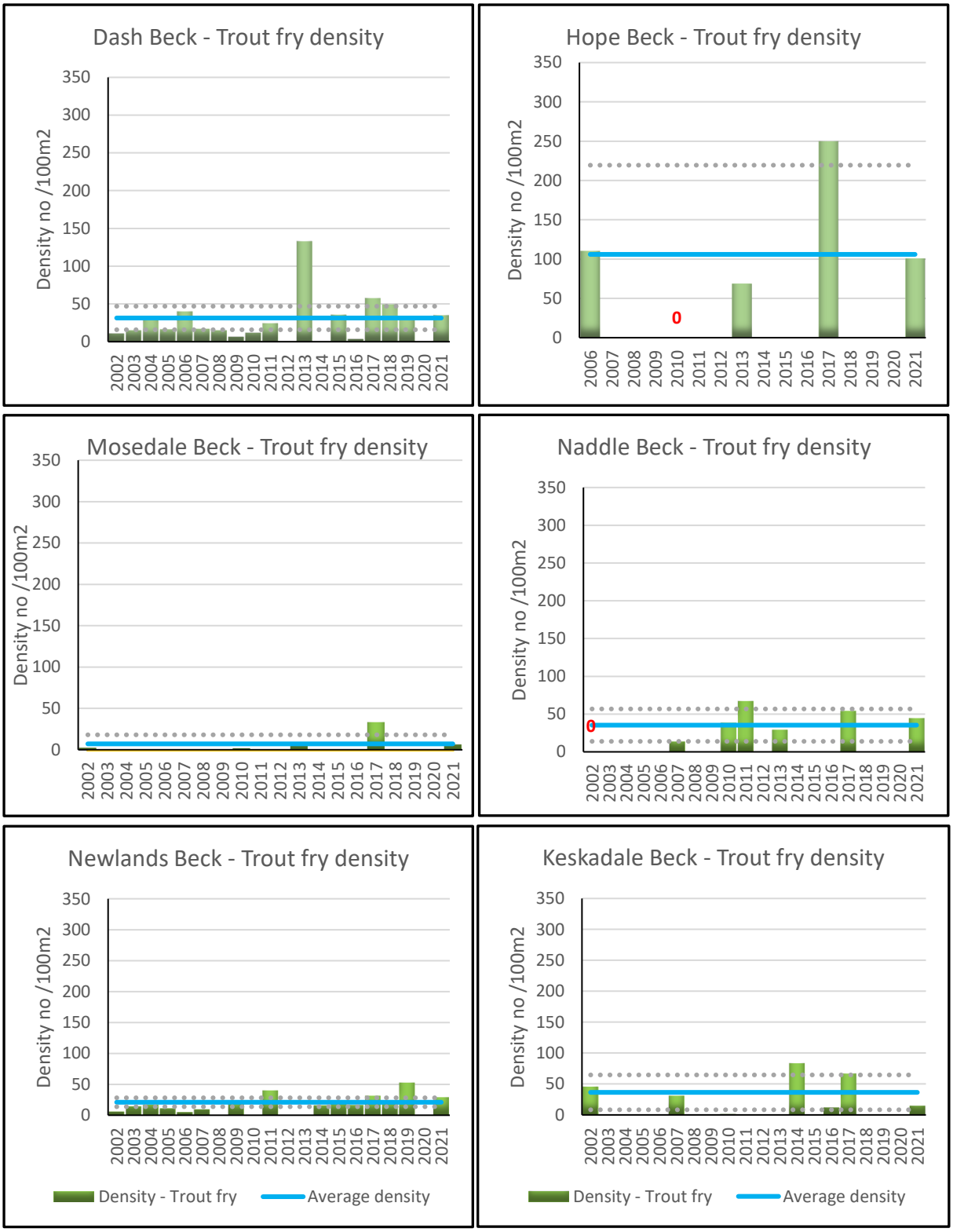
The final stage of the Decision Structure is the selection and implementation of the appropriate regulatory action.

Appendix 2 – Juvenile salmonid data



Appendix 2a: Salmon fry densities at 11 regular Derwent catchment electro-fishing sites, including site average density (blue line) and 95% confidence limits (dashed grey lines). These sites were surveyed on 7 or more occasions since the mid 1990's.

Note: Surveys that yielded no fish are labelled with a **'0'**. The data reflects that which is available. Some sites have been surveyed more frequently than others. The average line reflects the average density at that site specifically


Dash Beck - Trout fry density
Density no /100m2
Hope Beck - Trout fry density
Density no /100m2
0
Mosedale Beck - Trout fry density
Density no /100m2
Naddle Beck - Trout fry density
Density no /100m2
0
Newlands Beck - Trout fry density
Density no /100m2
Keskadale Beck - Trout fry density
Density no /100m2
Density - Trout fry
Average density

Appendix 2b: Trout fry densities at 12 regular Derwent catchment electro-fishing sites, including site average density (blue line) and 95% confidence limits (dashed grey lines). These sites were surveyed on five or more occasions since the mid 1990's.

Note: Surveys that yielded no fish are labelled with a **'0'**. The data reflects that which is available. Some sites have been surveyed more frequently than others. The average line reflects the average density at that site specifically.

Site	NGR
1584.00 Bassenthwaite village, Dash Beck	NY2296032330
1637.20 Hope Beck, River Cocker	NY1665823903
1554.00 Wallthwaite, Mosedale Beck	NY3532726215
1556.00 Shoulthwaite, Naddle Beck	NY3004020621
1570.00 Little Braithwaite, Newlands Beck	NY2381923042
1573.40 Keskadale Beck, Newlands Beck	NY2134119217
1597.00 Isel Hall, Blumer Beck, River Derwent	NY1566333803
1547.20 US of Trout Beck, River Glenderamackin	NY3589626882
1704.00 Calva Hall, River Marron	NY0587026448
1715.00 Snary Beck, River Marron	NY0840022600
1555.20 Low Bridge End, St. John's Beck	NY3176820544
1642.00 US road bridge to Hopebeck, Whit Beck	NY1575524964

Appendix 2c: **Above** - 12 key Derwent catchment juvenile salmonid monitoring sites, as referenced in this report. Yellow highlights relate to the six sites used in relation to figure 2.12. **Below** – map showing their distribution around the catchment.

Note: Hope beck excluded from salmon juvenile discussion due to lack of access/suitability for salmon.