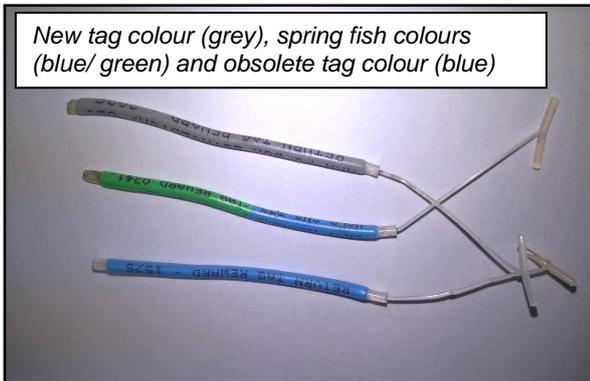
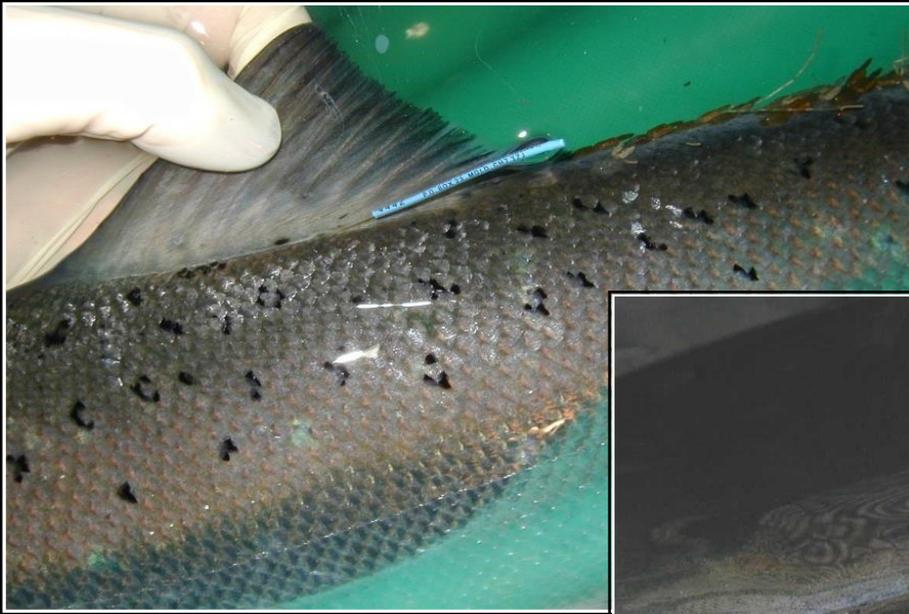


DEE STOCK ASSESSMENT PROGRAMME
ANGLER REPORT 2020



Cyfoeth Naturiol Cymru
Natural Resources Wales

Front cover: Sea trout in the release pool at Chester fish trap



Photos: Floy tagged salmon and VI (Visible Implant) tagged sea trout.

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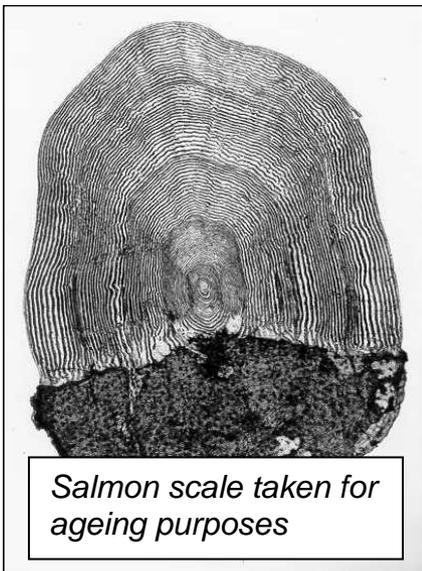
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1. Introduction

The River Dee is one of very few 'index' monitored rivers for Atlantic salmon and sea trout in Europe or the wider North Atlantic area. It is the only index river in Wales and a Special Area of Conservation for salmon under the EU Habitats Directive.

Index rivers are characterised by their intensive and long-term monitoring programmes collecting unique information on the key life-stages of these important fish species.

Over time, this builds a picture of changes in the abundance and biological characteristics of fish stocks in order to improve understanding of complex population processes and the factors which influence them.



Salmon scale taken for ageing purposes

In turn, this detailed information is used to inform stock assessment and fisheries and environmental management in the widest sense: local, national and international. Hence the benefits are not just confined to the index rivers.

The index river programme on the Dee - or 'Dee Stock Assessment Programme' (DSAP) - began in 1991 with construction of a head-of-tide fish trap at Chester Weir.

This trap is designed to capture and sample upstream migrating adult fish and estimate their total return, as well as provide information on their biology (e.g. size, age, sex, etc.). Further details of the trapping programme are given below.

Other elements of the Dee programme include:

- (i) lower river downstream trapping programmes in Spring to estimate the abundance and survival of out-migrating smolts;
- (ii) extensive (5-minute timed) electrofishing surveys in late summer to monitor the abundance and distribution of juvenile salmon and trout (fry and parr) at 85+ tributary and main river sites.
- (iii) circulation (with this report) of a fishing logbook to Dee anglers to collect detailed information on rod catch and fishing effort around the catchment - supplementing the licence based catch return and fostering support for the Dee programme including the reporting of tagged fish.



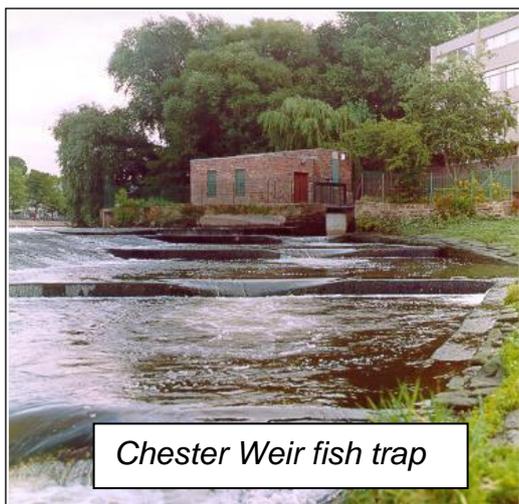
Salmon and trout fry sampled by electrofishing

The purpose of this report is to provide provisional findings on aspects of the Dee programme and related work for 2020. It is one of a series of annual reports on the Dee programme produced by Natural Resources Wales (NRW) and predecessor bodies.

From 2010 (to 2020) the Dee programme, along with other salmon monitoring work in the UK, has been supported by the EU Data Collection Framework - receiving up to 80% grant funding.

2. Trapping and tagging at Chester Weir

Very few rivers have facilities (counters or traps) to estimate the numbers of salmon or sea trout returning each year. Out of more than 60 principal salmon rivers and around 80 principal sea trout rivers in England and Wales (E&W), only 12 currently provide run estimates for salmon (including the Taff, Teifi and Dee in Wales) and just 5 produce the same estimates for sea trout (only the Dee in Wales). Among these rivers, five 'index' rivers: Tyne, Frome, Tamar, Dee and Lune, also collect biological information from adult fish via trapping or fishery-based sampling programmes (of which the Dee is the longest running).



Trapping at Chester Weir is carried out throughout the year (January - December) but not continuously. When the trap is not being fished (around 50% of the time) it becomes an 'open channel' through which fish can freely pass. For this reason, and because fish are able to cross the weir and bypass the trap in high flows and on big (~9m) tides, the trap is a 'partial' one. Tagging and recapture estimates (below) indicate that, on average, 20-30% of the run is trapped at Chester.

Virtually all salmon and the majority of sea trout captured at Chester Weir are tagged using Floy and VI (Visible Implant) tags, respectively (see photos on inside front cover). In both cases, run estimates require a second catch from which the ratio of tagged to untagged fish can be obtained. For salmon, this relies on anglers reporting the tagged and untagged fish they catch in the same year they were tagged. In the case of sea trout, however, (where, unlike salmon, multiple spawners are common) the second catch takes place back at Chester Weir trap one year after tagging. In both instances, the ratio of tagged to untagged fish in the second catch is used to raise the total number tagged to obtain a run estimate. For example, if 1,000 salmon were tagged at Chester Trap, and 1 in 5 of the salmon caught by anglers were tagged, then it is assumed that 1/5th of the run has been tagged - producing a run estimate at Chester of 5,000 fish.

The tagging and recapture method means that run estimates for salmon and sea trout can be obtained from a partial trapping programme; i.e. they do not require trapping to be carried out all the time and do not depend on a constant trapping efficiency (as the latter can be estimated from tagging).

A £10 cash reward (increased from £7 in 2020) is offered to encourage anglers to report any tagged salmon they catch. This reward is increased to £20 (from £14 in 2020) for anglers who returned a logbook in the previous season. The reason for this is that records of tagged and untagged salmon submitted by logbook anglers are considered the most reliable - simply because of the effort required to maintain a detailed record of each fishing visit. Hence, only the catch and recapture details from logbook anglers are used to generate salmon run estimates.

The run of salmon entering the Dee after the end of the angling season (on average around 5% of less of the total) is derived from the trap catch and an estimate of trap efficiency from the in-season period.

3. COVID-19 and the Dee programme in 2020

The COVID-19 pandemic has clearly had a huge impact on many aspects of life in the UK and across the world in 2020 and into 2021, not least on health, the economy and education.

‘Lockdowns’ in UK jurisdictions and related restrictions on travel and social distancing would have affected the ability to go fishing, particularly in the early part of the 2020 season.

The same restrictions meant that homeworking has been (and remains) the norm for NRW staff since late March last year. The same restrictions resulted in a halt to trapping activity at Chester between late March and mid-May 2020 while safe ways of working were devised and approved. From mid-May onward, however, trapping and tagging of adult salmon and sea trout continued pretty much as normal.

Other sampling – undertaken as part of the Dee programme or carried out more widely as part of NRW’s salmonid monitoring work, was more significantly affected by the COVID-19 pandemic.

Routine electrofishing (EF) surveys for juvenile salmonids were cancelled across Wales (as well as in England and other UK jurisdictions) primarily because of the constraints imposed by social distancing. Some 5-min timed surveys (two-man operation with battery operated back-pack gear) were carried out on the Dee at around 30 sites late in the year once H&S concerns were addressed (this survey usually targets more than 80 fixed sites on the Dee each year).

The trapping and Coded Wire Tagging (CWT) of smolts in April/May at lower Dee sites using Rotary Screw Traps was also cancelled for similar reasons (as was work to catch and acoustically tag smolts on the upper Dee at Bala and the River Usk – both relating to investigations to examine the migratory

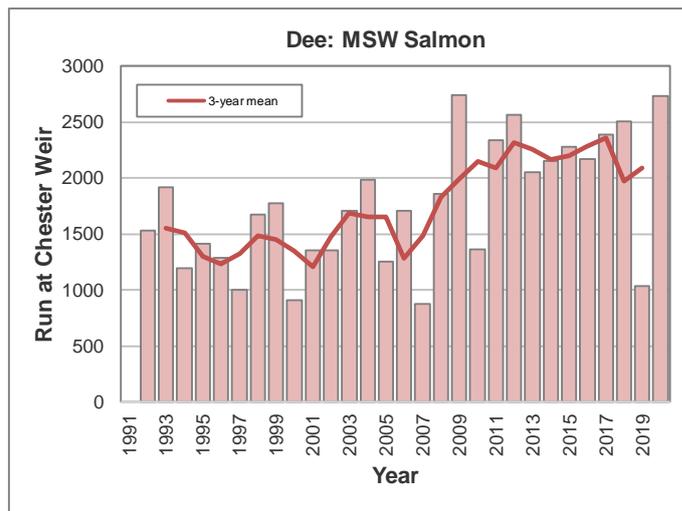
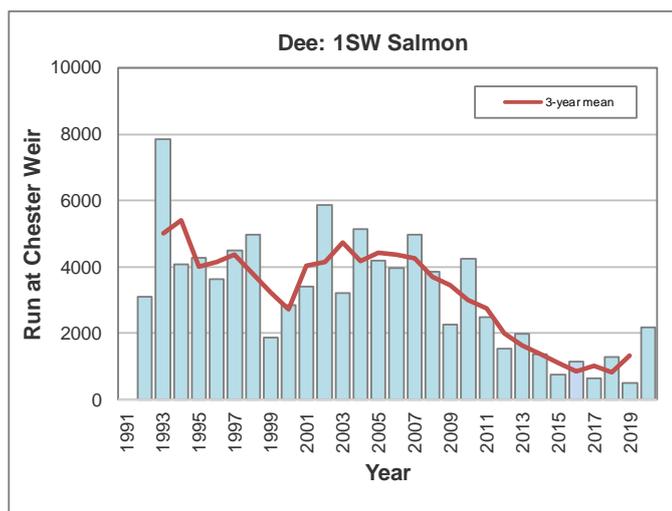
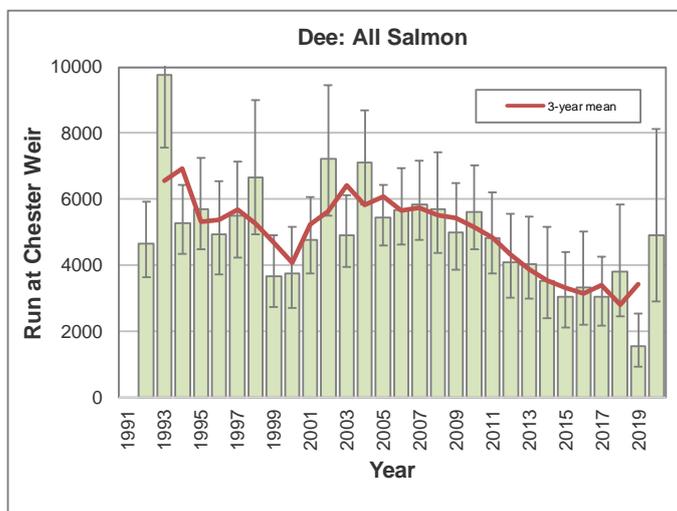
behaviour and losses of smolts around man-made structures). That said, around 600 salmon smolts were opportunistically captured and CWTagged at Chester Weir in late May-June 2020 as small shoals gathered in the trap during low flow conditions.

One aspect of the monitoring that continued, unaffected, across England and Wales in 2020 was the collection and reporting of net and rod catch returns.

4. Dee salmon in 2020

Run size and composition: Provisional results indicate a run of 4,916 salmon (fish of all sea ages) at Chester in 2020 - the best return for around a decade and just below the long-term (1992-2019) average (Fig 1). The corresponding trap catch in 2020 was 558 salmon.

Fig. 1 Annual run estimates for salmon at Chester Weir, 1992-2020
(error bars indicate 95% confidence intervals)



The run of multi-sea winter (MSW) salmon was the second highest recorded at 2,730 fish. Numbers of 1-sea winter (1SW) salmon (or grilse) also showed a reasonable up-turn on recent poor years – totalling 2,186 fish. Overall, returns in June and particularly July appeared exceptionally good. However,

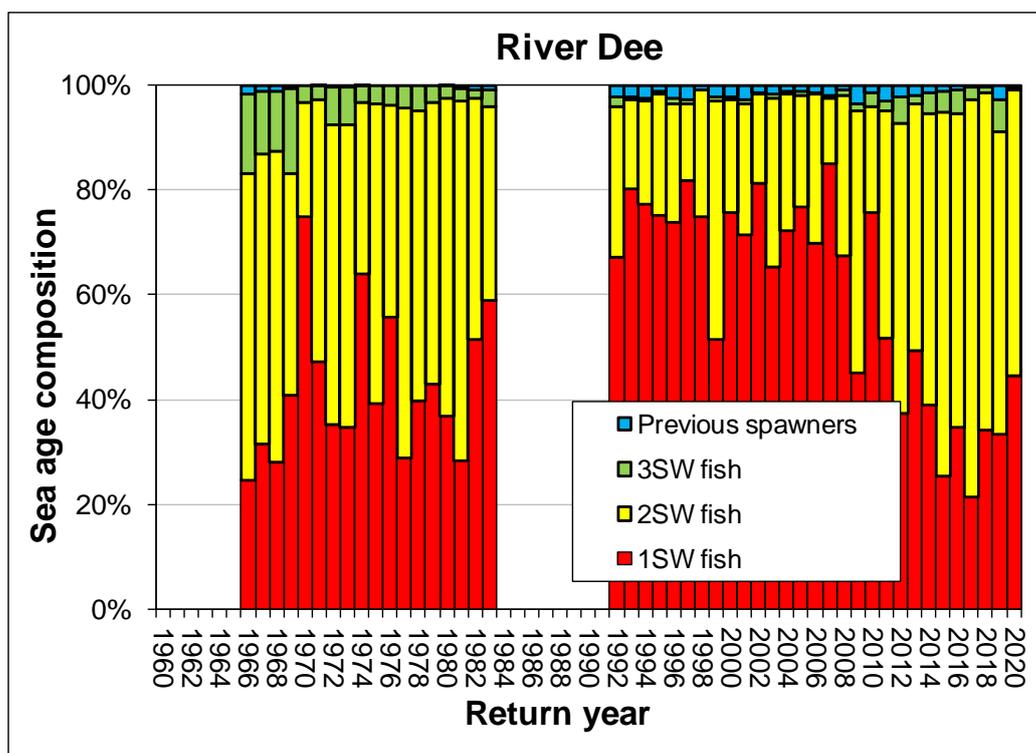
as in recent years, very few fish were captured at Chester after the end of August – in-keeping with the marked reduction in numbers of grilse and particularly later season grilse evident in the last 10 years or so.

MSW fish continue to dominate the salmon run on the Dee comprising 56% of the total, when, less than 20 years ago, grilse made up 70-80% of a larger return.

The Dee is not alone in experiencing a recent marked reduction in the overall abundance of returning salmon linked to a decline in grilse numbers. For example, the same pattern of decline is also evident on most index/counted rivers in E&W.

The long-term data set from the Dee indicates that this may be part of a cyclical pattern - with the contribution of 1SW salmon in the last few years appearing similar to that 50 years ago when up to 80% of the return was made up of MSW salmon (Fig 2).

Fig. 2 Sea age composition of salmon on the Dee, 1960-2020



Long-term cyclical changes in abundance of grilse and multi-sea winter salmon, evident from historic data sets, have been linked to similar cyclical processes affecting environmental conditions in the North Atlantic.

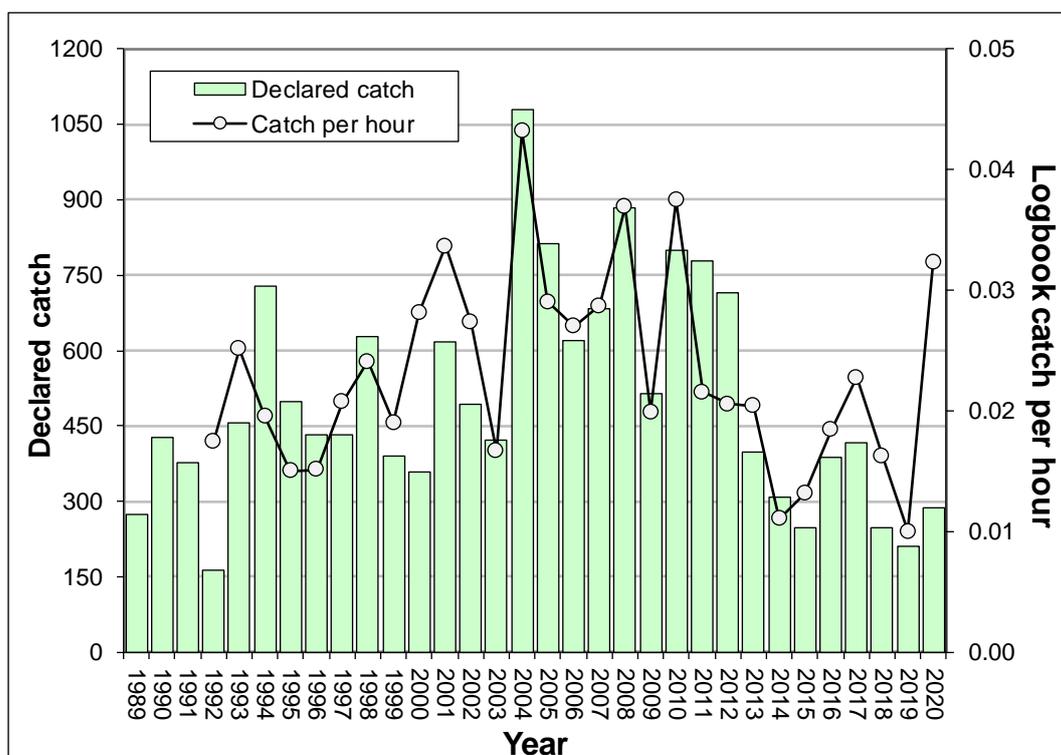
It is possible we may be experiencing the trough of such a cycle now, however, there is no certainty that this is the case. Factors such as global warming - not so evident or potentially damaging 50 years ago, may also be at play.

Hence, the precautionary management response is to protect vulnerable stocks now so they are best placed to respond to the return of more favourable environmental conditions in the future.

Rod catch: Licence returns to date indicate a declared rod catch on the Dee of 286 salmon - an improvement on the 211 fish reported in 2019 (one of the lowest on record) but still well below the 30-year average catch of ~500 fish (Fig 3). Catch per hour figures from logbook returns show a similar pattern to the declared catch. The estimated angling 'exploitation rate' on Dee salmon in 2020 (i.e. the proportion of the annual run caught by rod fishermen) was the lowest to date at 6.4% and less than half of the recent 10-year average rate of 13.0%.

Of the 286 salmon caught in 2020, all were released by anglers – complying with the newly introduced byelaws.

Fig. 3 Salmon rod catch and catch per hour, 1989-2020



Spawning escapement: Estimates of the numbers of spawning salmon and the eggs they deposit are based on the run at Chester Weir minus losses to the rod fishery and other sources of mortality. Estimates also take account of the sex ratio of returning fish sampled at Chester (as judged from external appearance - the ratio is usually close to 1:1) and their average size (which relates to their likely egg contribution).

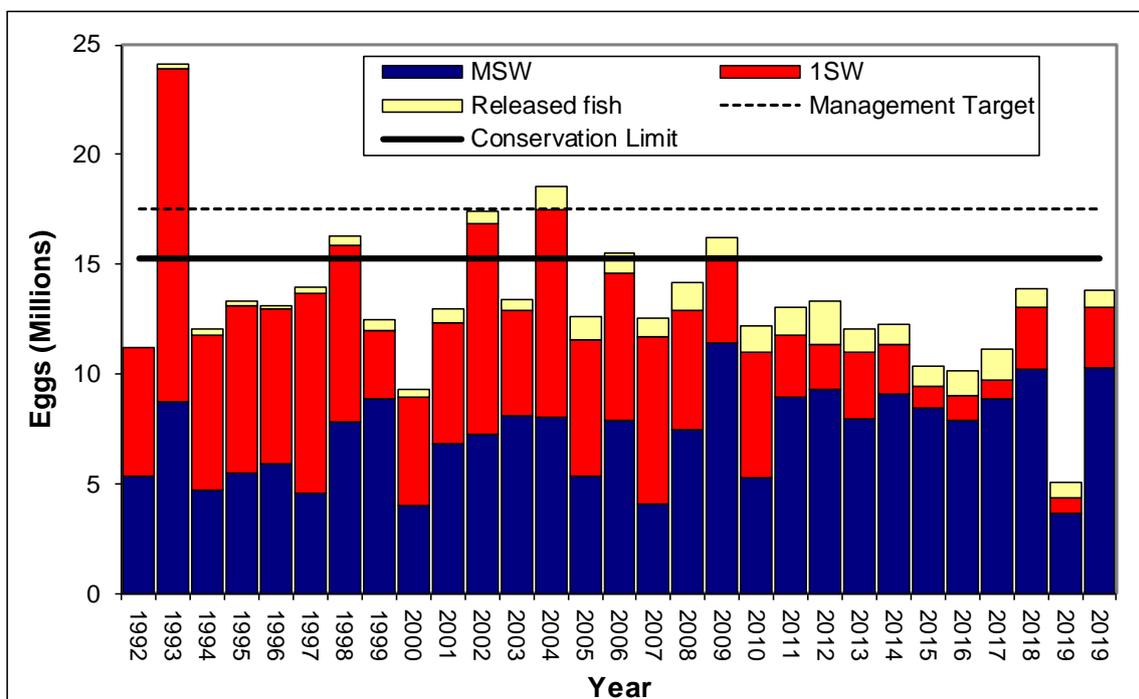
The provisional estimate of egg deposition on the Dee in 2020 is 13.8 million eggs - produced by ~4,500 spawners. Of these, close to 300 spawners were estimated to have been rod-released fish contributing 0.76 million eggs. For the eleventh year running, egg deposition was below the Conservation Limit

for the Dee of 15.3 million eggs and well short of the associated Management Target of ~17 million eggs (Fig 4).

The ‘Management Objective’ for all salmon rivers in Wales (and England) is that stocks should meet or exceed their Conservation Limit 80% of the time, or 4 years out of 5, in the long term.

To assess whether this Management Objective is being met, a trend based statistical compliance procedure is applied to egg deposition estimates from the last 10 years. This procedure tests whether a stock is formally passing (‘not at risk’) or failing (‘at risk’) its Conservation Limit, or has some intermediate status (‘probably not at risk’ or ‘probably at risk’). On this basis, ‘risk’ status is usually reported for the current year and (based on an extrapolation of the trend line) in 5-years time.

Fig. 4 Salmon egg deposition 1992-2020



The Management Target provides an indication of the average number of spawners required (expressed as eggs or adults) to ensure compliance with the Management Objective.

The Management Target is a ‘target’ reference point (i.e. something to ‘aim at’) whereas the Conservation Limit is a ‘limit’ reference point (a lower threshold below which stocks become increasingly vulnerable and which we want to avoid). Statistical compliance procedures ensure there is a high probability (i.e. the 4 years out of 5 ‘rule’) that stocks classified as healthy are indeed above their Conservation Limit.

This terminology and the associated assessment procedures - in place in E&W since the early 1990s - are in line with the now long-standing recommendations of ICES (International Council for the Exploration of the Sea) and NASCO (North Atlantic Salmon Conservation Organisation).

Conservation Limits are applied in a similar way by other jurisdictions (e.g. in Ireland and Scotland), with similar management consequences for failing stocks.

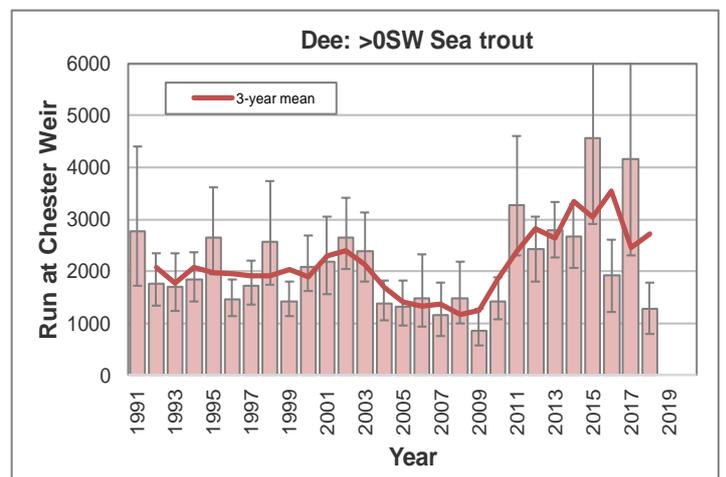
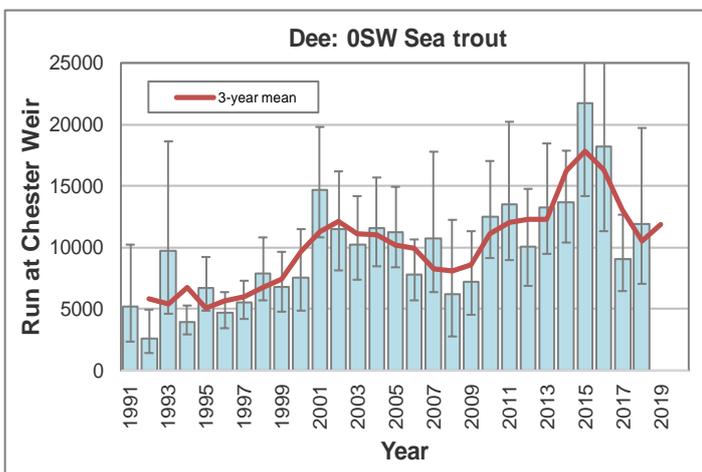
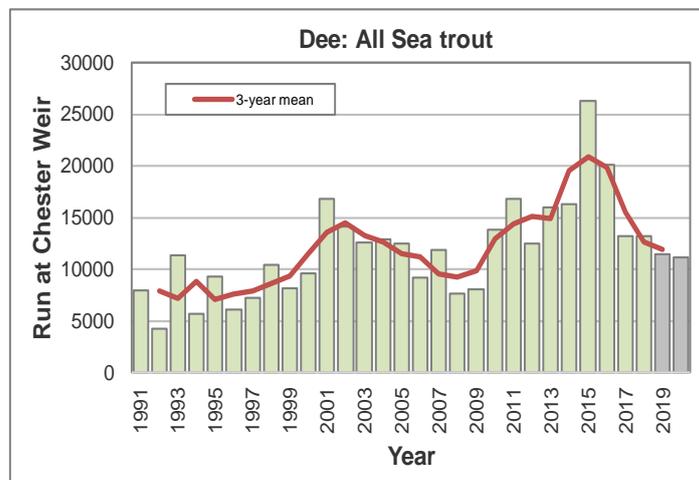
Provisional results from Conservation Limit compliance assessment in Wales in 2020 indicate all river stocks of salmon as being ‘at risk’ or ‘probably at risk’ – both in the current year and projected 5-years into the future, with most stocks exhibiting a declining trend over the last decade. The Dee salmon stock was classified as being ‘probably at risk’ both in 2020 and projected to 2025.

5. Dee sea trout in 2020

Run size and composition: As described in Section 2, run estimates for sea trout on the Dee rely on the recapture of fish back at Chester trap in the year after tagging - and so are 12 months behind those of salmon.

Separate run estimates are obtained for whitling (0SW) sea trout (i.e. fish which spend only a few months at sea and weigh around 1lb or less on their return) and older (>0SW) fish. Run estimates for 2019 are still being worked on. In 2018, the run estimate for whitling sea trout was 11,894 - above the long-term average return of ~9,700 fish. Numbers of older sea trout, however, at 1,281, were well below the long-term average of ~2,200 fish (Fig 5).

Fig. 5 Annual run estimates for sea trout at Chester Weir, 1991-2020
(error bars indicate 95% confidence intervals)



In 2019 a total of 2,379 0SW and 177 >0SW sea trout were captured at Chester trap. A similar total catch of 2,356 sea trout was recorded in 2020, but initial examination indicates that this included much better return of >0SW sea trout than in 2019. This will be confirmed once all scale reading (to age the fish) has been completed.

On the basis of trap catches, tentative run estimates for all sea trout in 2019 and 2020 of ~11,400 and ~11,100 fish are shown in Fig 5. These estimates continue the downward trend in the sea trout return evident since 2015, but are still close to the long-term average.

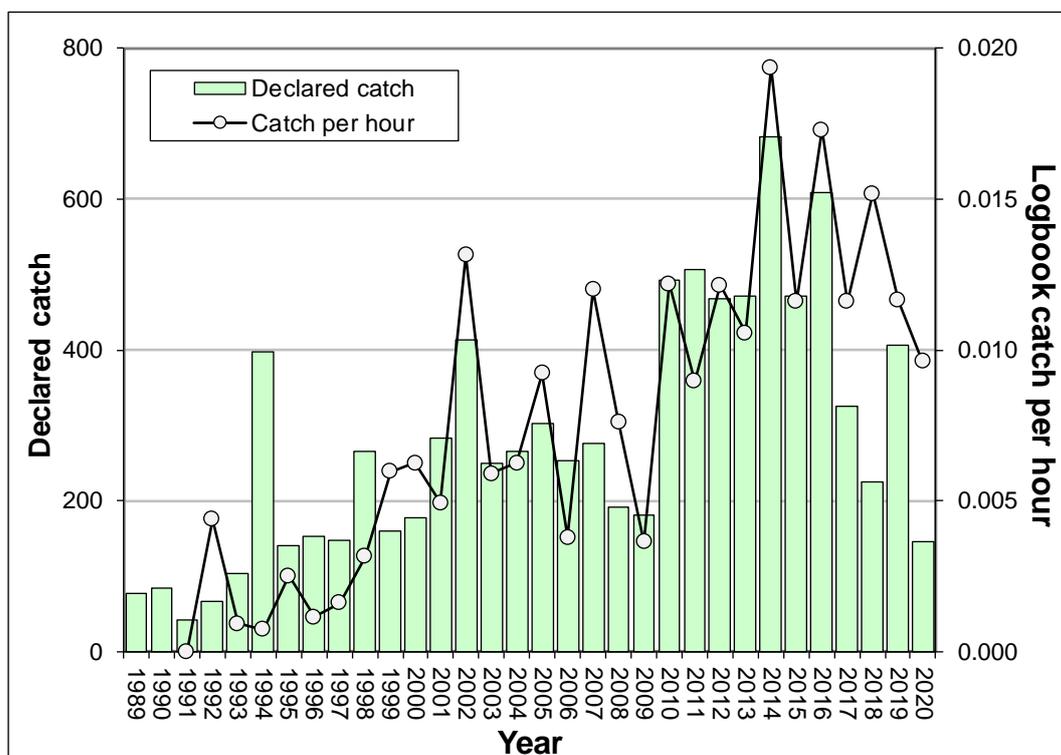
Rod catch: Provisional sea trout rod catch figures for the Dee in 2020 stand at 145 fish – well below the long-term average catch of 324 fish. As with salmon, there is strong correspondence between declared rod catches of Dee sea trout and catch per hour figures obtained from logbook returns (Fig. 6).

In 2017, a new method was introduced in Wales to evaluate the status of sea trout stocks. This derives Conservation Limits for individual river stocks and assesses compliance using approaches similar or identical to those used in salmon; for further details see:

<https://naturalresourceswales.gov.uk/guidance-and-advice/business-sectors/fisheries/salmon-and-sea-trout-stocks-in-wales/?lang=en>

Using these approaches the Dee sea trout stock was classified as ‘probably at risk’ in 2019.

Fig. 6 Dee sea trout rod catch and catch per hour 1989-2020



6. Catch location and time to capture.

Fig. 7 Salmon rod catch by river section 2001-2020

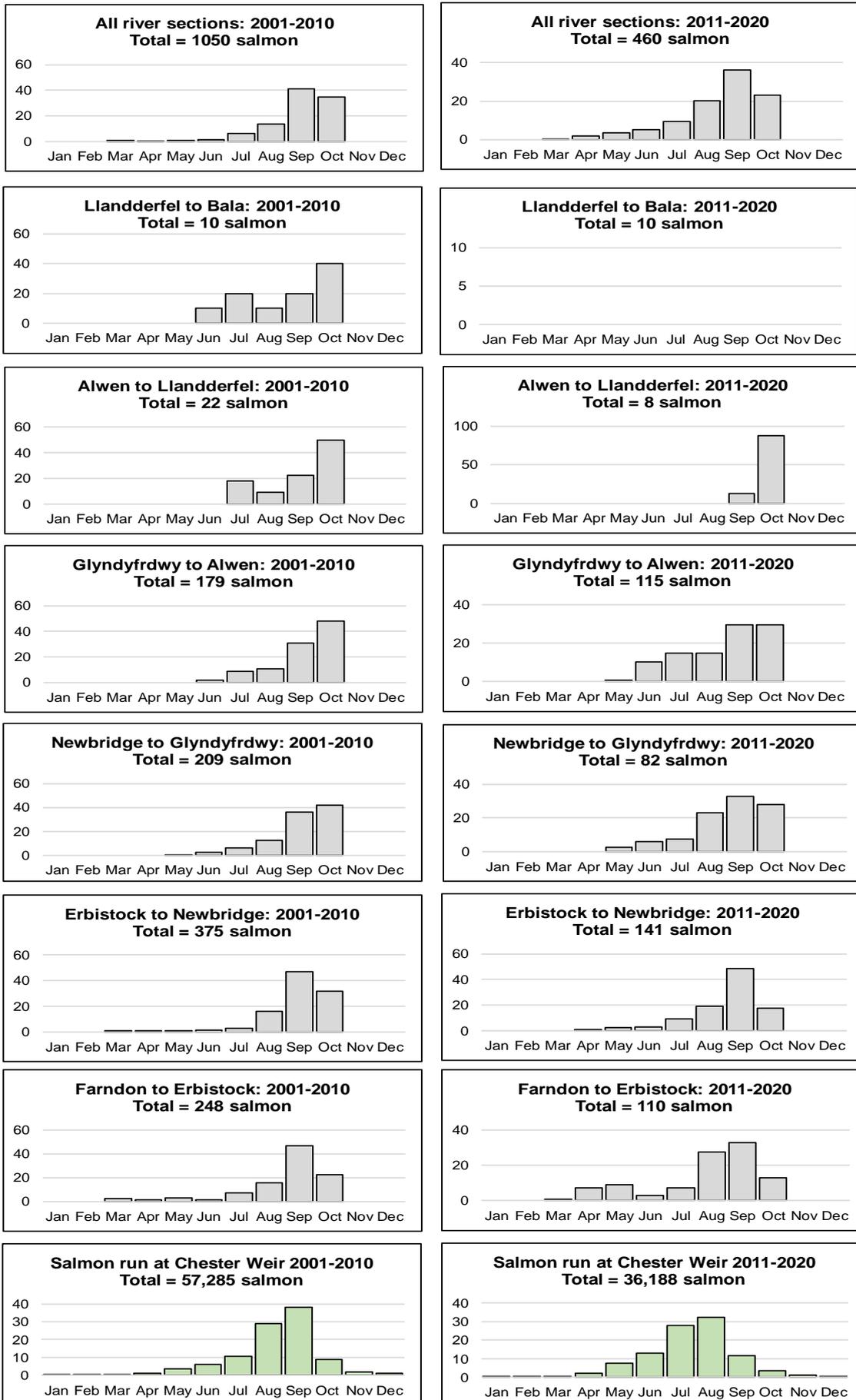
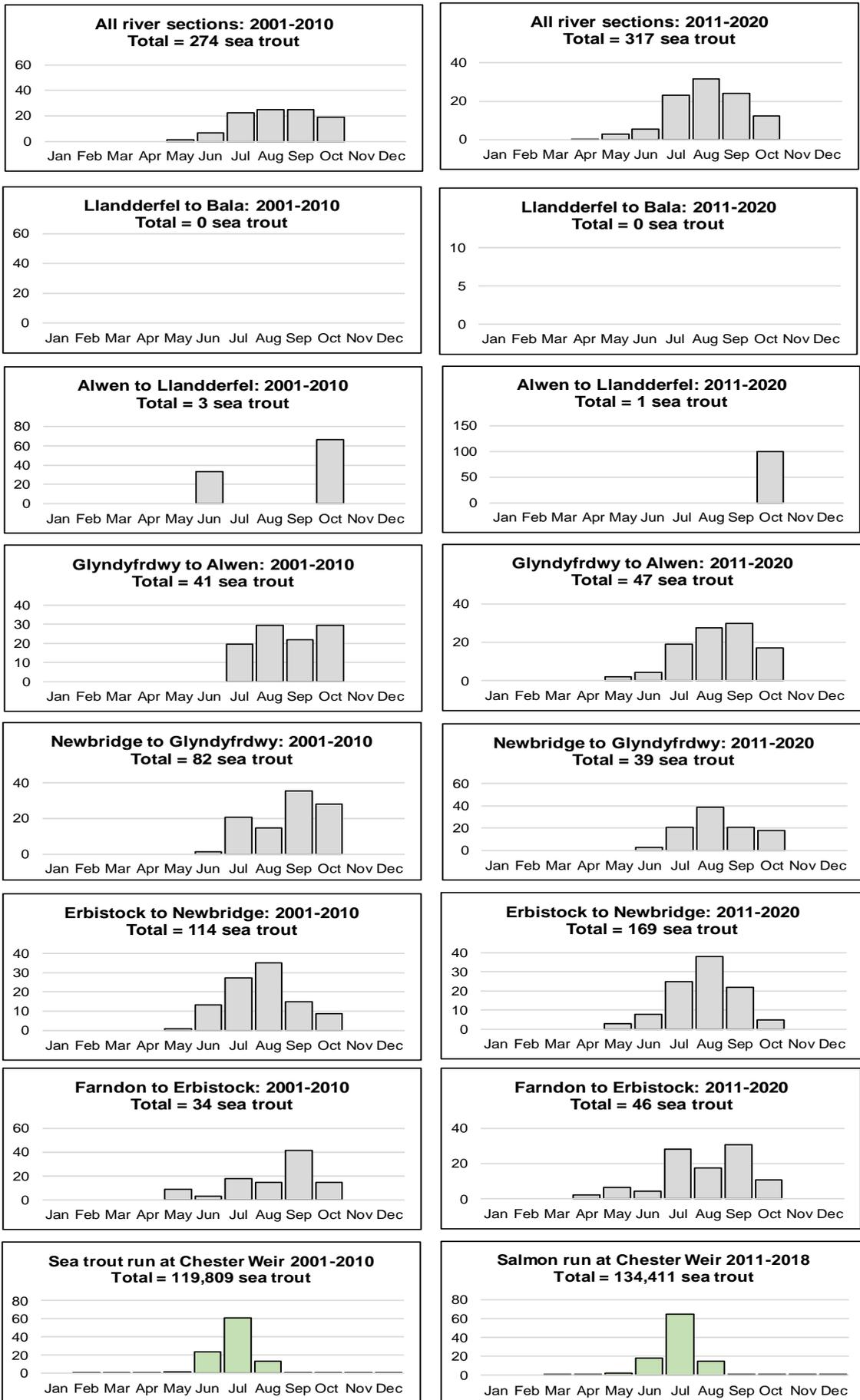


Fig. 8 Sea trout rod catch by river section 2001-2020



Figs 7 and 8 show the monthly distribution of the salmon and sea trout rod catch reported by logbook fishermen in each of the six main river angling sections over the last two decades (2001-2010 and 2011-2020). Monthly catches in each section are expressed as a percentage of the total for that section (i.e. the bars shown for each graph add up to 100%).

The graphs in the top row of Figs 7 and 8 show the monthly distribution of the catch for all locations combined. The graphs in the bottom row of Figs 7 and 8 show the distribution of the total run at Chester Weir. On each graph, the total numbers of fish used to calculate the monthly percentage figures are given.

Both Figs 7 and 8 indicate that the majority of salmon and sea trout are caught in the first four river sections: i.e. from Farndon to the Alwen junction.

For sea trout, the monthly distribution of the catch in the lowest four angling sections appears similar between sections and between decades (2001-2010 and 2011-2020). This is also the case for the run at Chester Weir.

For salmon, differences in the monthly distribution of the run at Chester Weir are evident between the two decades, reflecting the decline in grilse numbers in the last 10 years (particularly later running grilse), but also the increase in MSW salmon (which tend to enter the river early and mid-season). The distribution of the salmon rod catch among the angling sections reflects this change in the run at Chester – with the catch (at least in the lowest four angling sections) being less concentrated in September and October; i.e. a greater percentage of fish now tend to be caught in the summer months June-August.

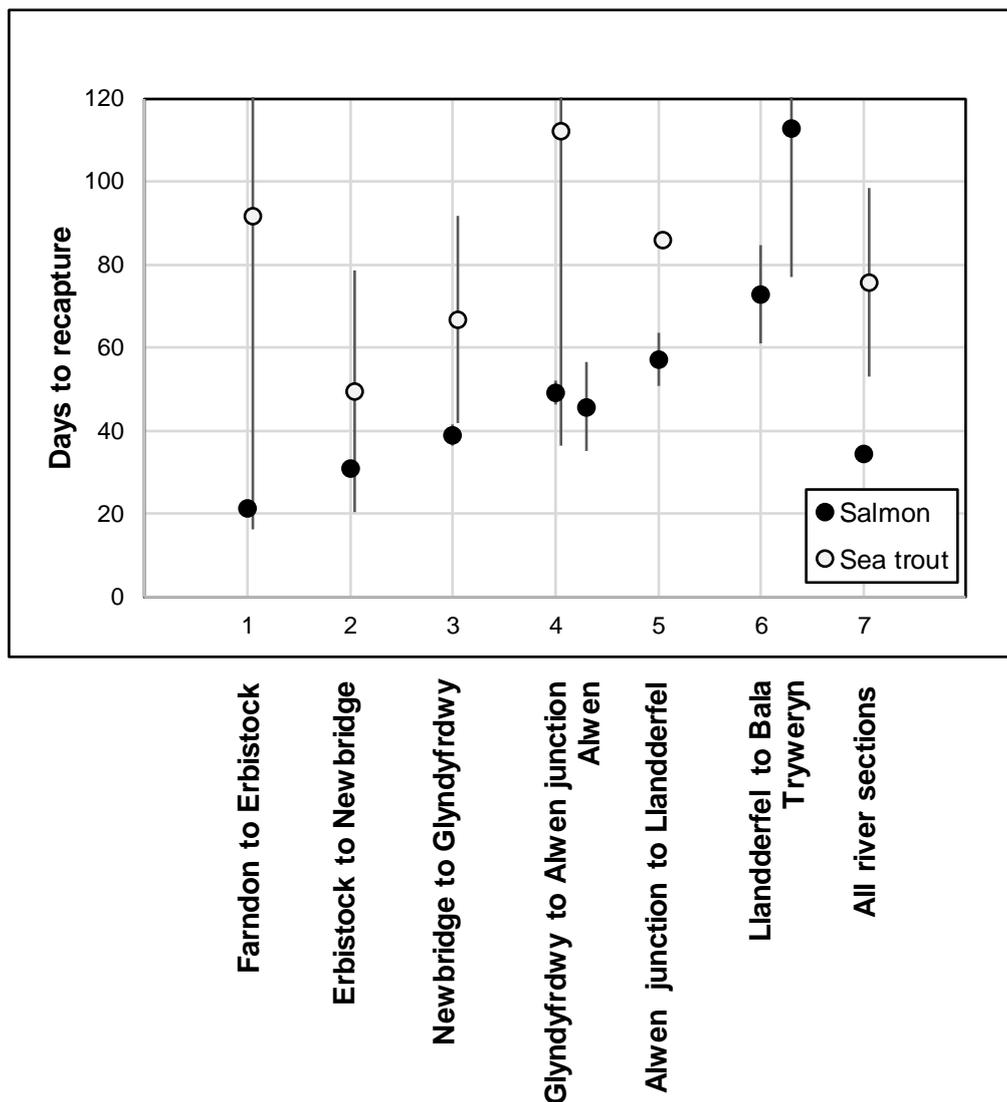
Fig 9 shows the average days to rod recapture (with 95% confidence limits) for salmon and sea trout tagged at Chester Weir. Results are arranged by angling section and for all sections combined.

The overall average time to recapture for salmon is 34 days (sample size 2,735 fish) compared to 76 days for sea trout (sample size 101 fish). As might be expected, recapture times for salmon increase progressively up-river, with for example, an average recapture time of 22 days in angling section 1 (Farndon to Erbistock) compared to 57 days in angling section 5 (Alwen junction to Llandderfel).

A similar pattern is evident in sea trout - although subject to greater variation given the smaller sample sizes. Within each river section, average sea trout recapture times are consistently greater than those of salmon.

The inherent delay between the arrival of fish at Chester Weir and subsequent capture by angling underpins the different patterns evident in Figs 7 and 8 between the monthly distribution of the salmon and sea trout run at Chester Weir and the monthly distribution of angling catches up-river.

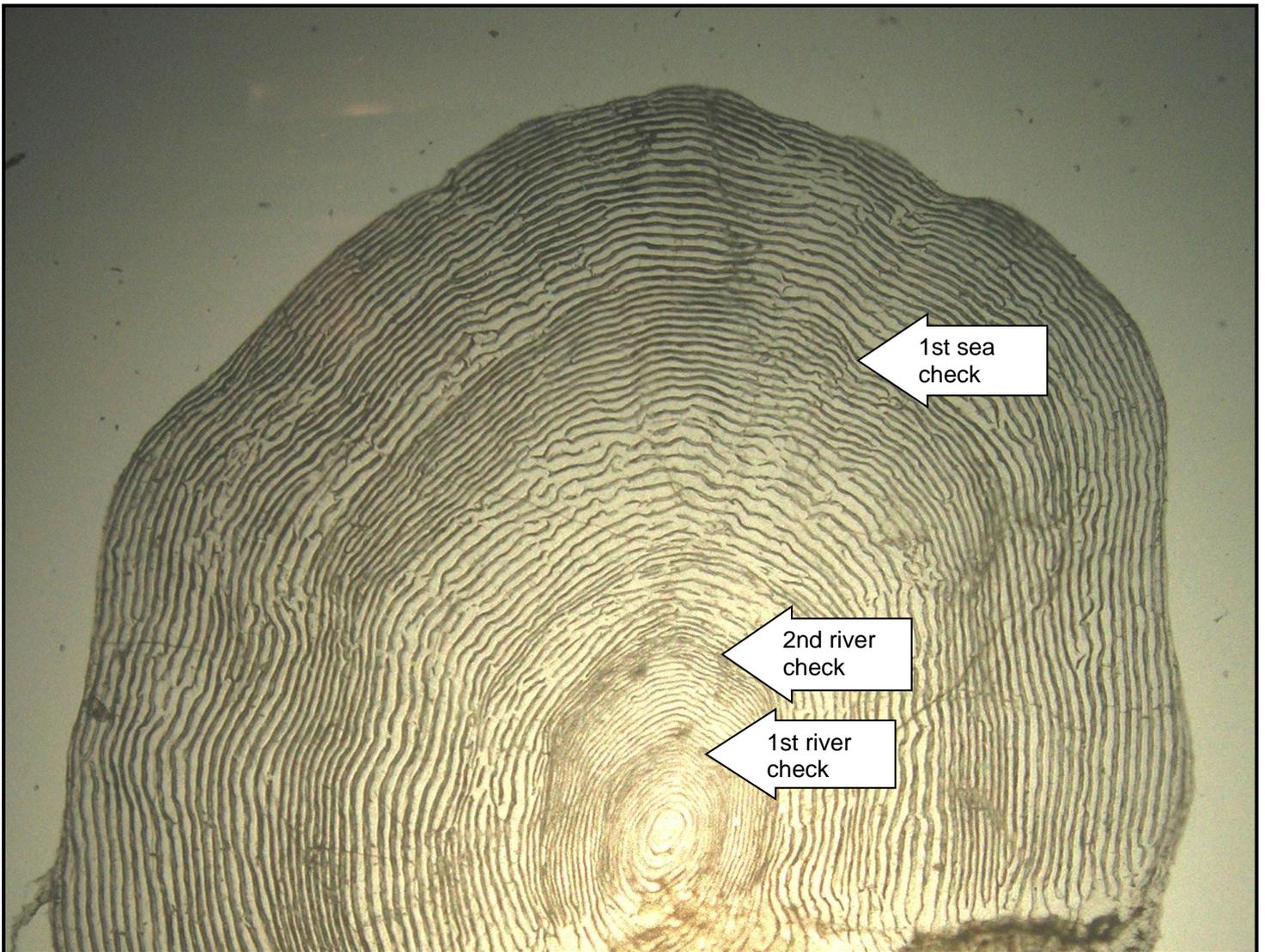
Fig. 9 Salmon and sea trout: Days to rod recapture by angling section 1992-2020



*Monitoring of Atlantic salmon and European eel in Wales is part-funded by the EU Data Collection Framework 2014-2020.
EU Funds: Investing in Wales*



Cronfeydd Strwythurol a Buddsoddi Ewropeaidd
European Structural and Investment Funds



A small number of scales (4-6) are routinely removed from adult salmon and sea trout captured at Chester Weir fish trap for ageing purposes. They are used to identify the year in which a fish hatched as well as the freshwater and marine age. 'Scarring' on the scale can also reveal past spawning events.

This information allows individual generations of fish to be followed through time; for example: to track survival or growth and examine the factors that may influence these processes.

This image shows a scale taken from a salmon which emigrated as a 2-year old smolt and returned as a 1-sea winter fish (or grilse).

In each year, a number of 'circuli' (concentric rings) are laid down. These circuli are widely spaced in the warmer months when growth is rapid but more tightly packed in the colder months as growth slows down. Slower growth in the latter period produces a darker band of circuli or a 'check' - which marks the end of a growth year.

Circuli laid down in the marine environment - where growth is usually rapid - also tend to be more widely spaced than those laid down in freshwater - where growth is much slower. On this basis, the marine and freshwater phases of the life-cycle can be readily distinguished.