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).

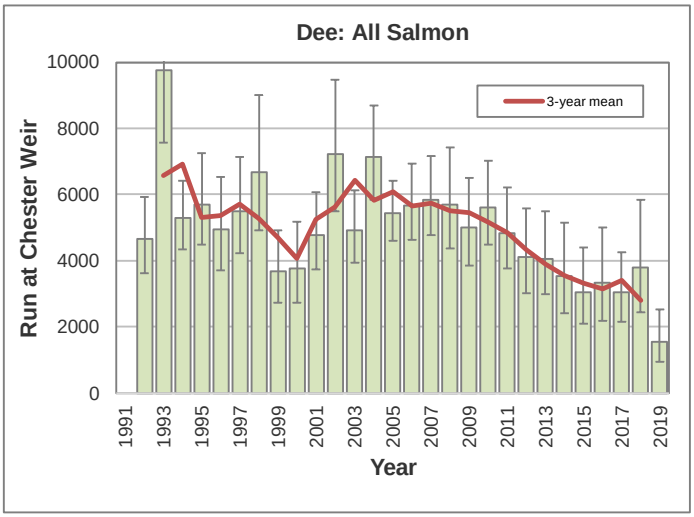
A £7 cash reward is offered to encourage anglers to report any tagged salmon they catch. This reward is increased to £14 for anglers who returned a logbook in the previous season. The reason for this is that records of tagged and untagged salmon submitted by logbook anglers are considered the most reliable - 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.

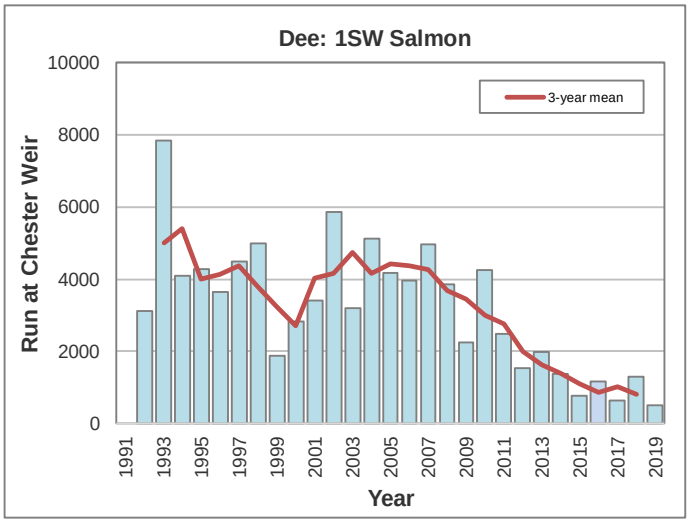
The run of salmon entering the Dee after the end of the angling season (on average less than 10% of the total) is derived from the trap catch and an estimate of trap efficiency from the in-season period.

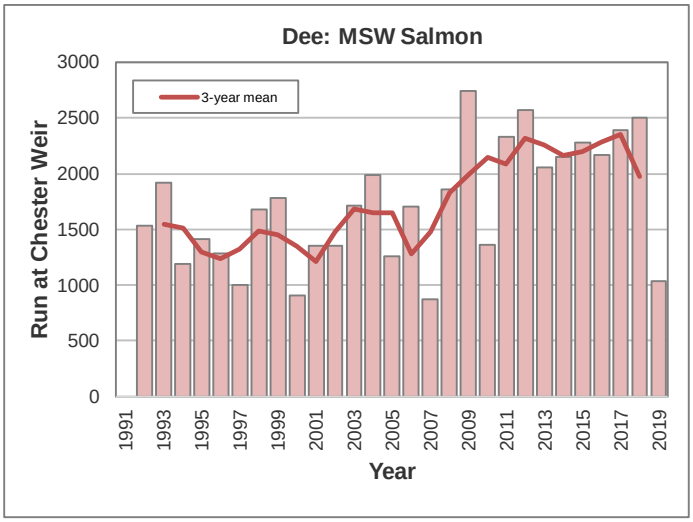
3. Dee Salmon in 2019

Run size and composition: Provisional results indicate a run of 1,551 salmon (fish of all sea ages) at Chester in 2019 - the lowest return on record (Fig. 1). The corresponding trap catch in 2019 was just 312 fish.

Fig. 1 Annual run estimates for salmon at Chester Weir, 1992-2019
(error bars indicate 95% confidence intervals)







The poor return in 2019 continues a pattern of near year-on-year decline in the Dee salmon run evident since the early 2000s - resulting in a current 3-year average return (~2,800 fish) which is less than half of the peak return of 2002-2004 (~6,400 fish).

As described in previous reports, this decline in the salmon run is being driven by a marked fall in the return of 1-sea winter (1SW) fish or grilse, such that current levels are now under 20% of what they were less than 20 years ago.

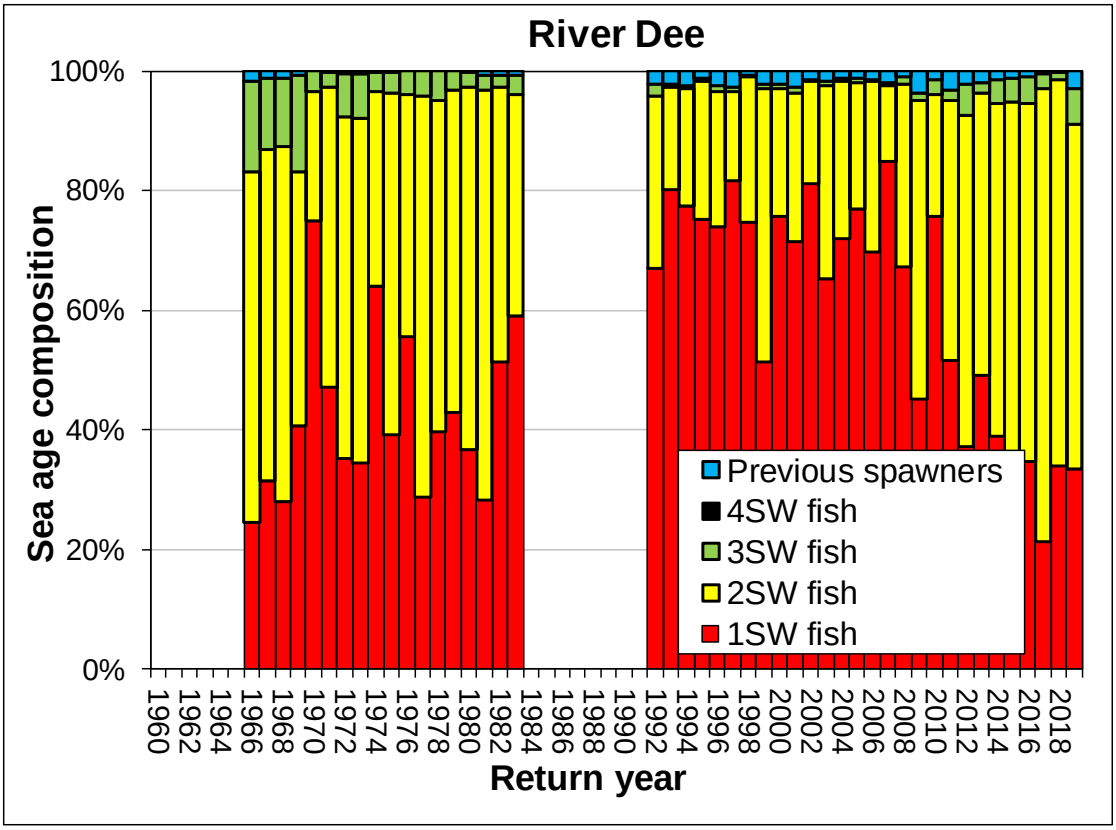
In contrast to grilse, the numbers of multi-sea winter (MSW) salmon returning to the Dee have (generally) been increasing in recent years. The estimated run of MSW salmon at Chester in 2019 (mainly 2-sea winter fish) dropped sharply to just 1,032 fish - the fourth lowest recorded in 28 years of monitoring.

Despite the poor return in 2019, MSW fish continue to dominate the salmon run on the Dee comprising 66% of the total, when, less than 20 years ago, grilse made up 70-80% of a much larger return.

The Dee is not alone in experiencing a marked reduction in the overall abundance of returning salmon linked to a recent 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 60 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, 1960-2019



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.

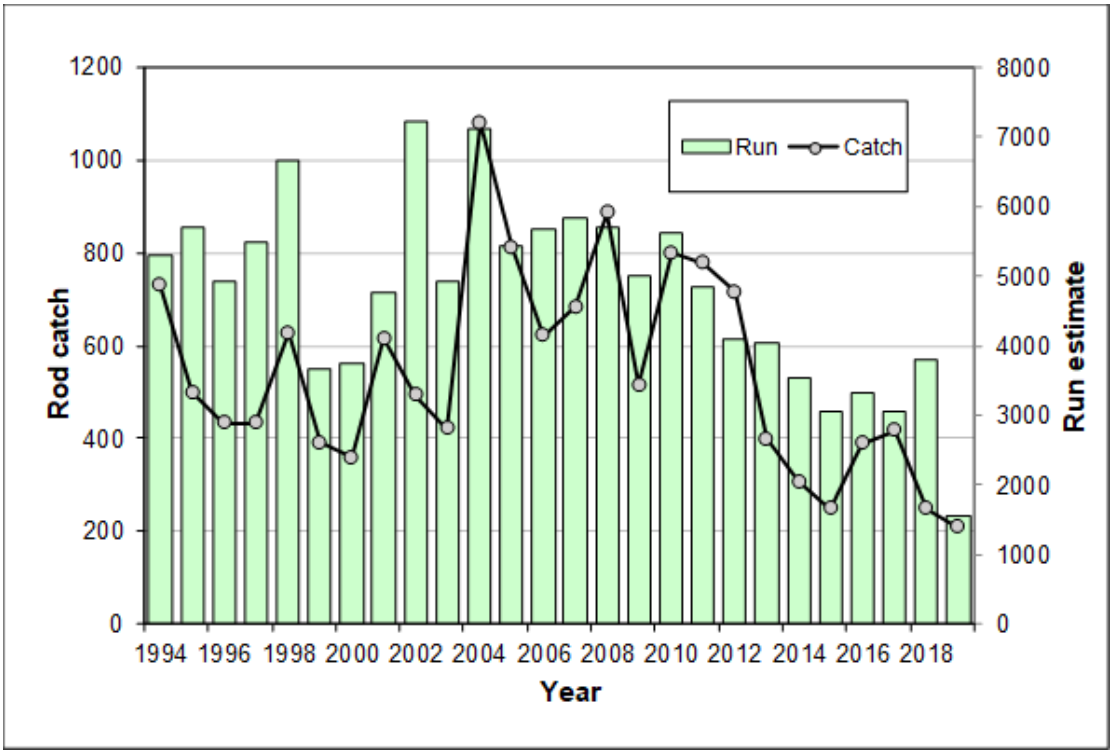
Hence, the precautionary management response is to protect vulnerable stocks now so they are best placed to respond to the return of more favourable environmental conditions in the future.

The particularly poor salmon return last year, aside from it continuing a pattern of general decline, would include fish of the 2016 year class - when there was strong (UK wide) evidence that recruitment of juveniles was badly affected by the winter storm 'Desmond'. Juvenile recruitment on the Dee was also affected in this way (see below) - an event which is also likely to have repercussions for adult returns in 2020.

Rod catch: Licence returns to date indicate a declared rod catch on the Dee of 208 salmon. This is the lowest catch on record (back to the 1950s) and reflects the similarly poor salmon run last year. The estimated angling 'exploitation rate' on Dee salmon in 2019 (i.e. the proportion of the annual run caught by rod fishermen) was 14.8% - above the previous 10-year average rate of 13.0%.

Of the 208 salmon caught in 2019, 196 or 94.2% were released by anglers - the second year in succession that release rates have exceeded 90%.

Fig. 3 Salmon rod catch and run estimates at Chester Weir, 1994-2019



There is a good degree of correspondence between the salmon rod catch on the Dee and the estimated run of fish at Chester Weir (Fig. 3). This is also true for a number of counted rivers - where angling catches and counts of returning fish are also highly correlated. These relationships provide assurance that catch data serve as meaningful indices of the numbers of salmon (and sea trout) returning to our rivers.

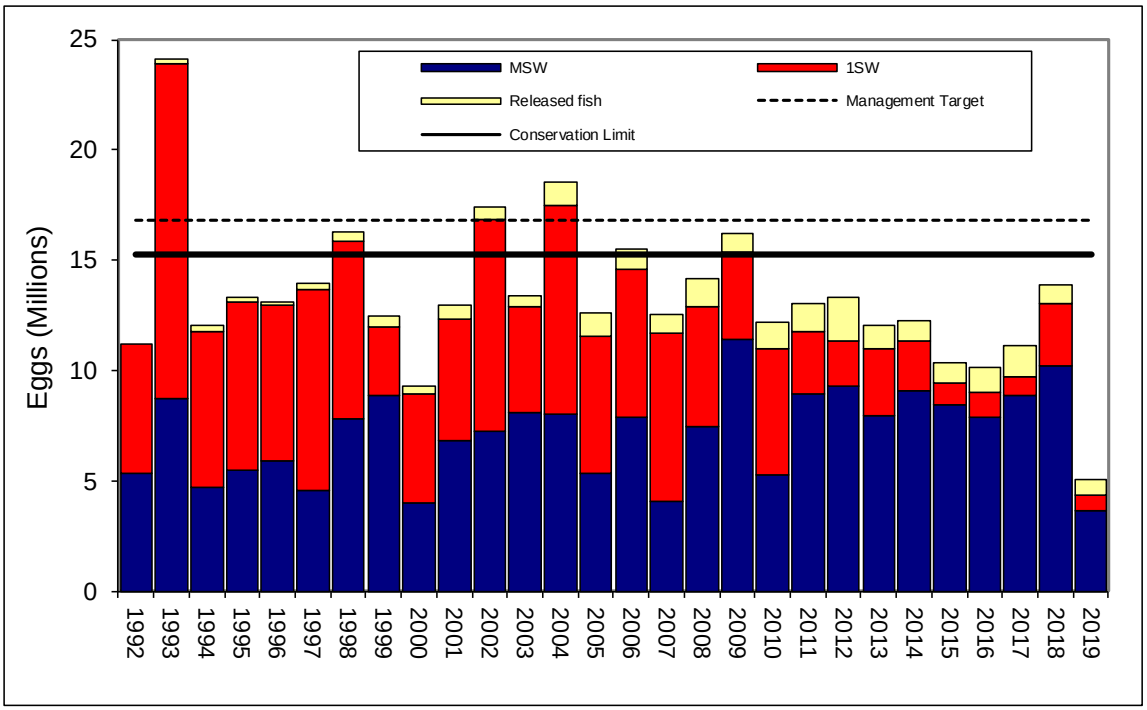
Spawning escapement: Estimates of the numbers of spawning salmon and the eggs they deposit are based on the run at Chester Weir minus losses to the rod fishery and other sources of mortality. Estimates also take account of the sex ratio of returning fish sampled at Chester (as judged from external appearance - 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 2019 is the lowest on record at 5.10 million eggs - produced by ~1,400 spawners. Of these, just over 170 spawners were estimated to have been rod-released fish contributing 0.69 million eggs. For the tenth 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').

Fig. 4 Salmon egg deposition 1992-2019



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 wish 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.

Conservation Limit compliance assessment in Wales in 2018 classified all river stocks of salmon as either 'at risk' or 'probably at risk', with most exhibiting a declining trend over the last decade. The Dee salmon stock was classified as being 'probably at risk' in the 2018 assessment (the 2019 assessment has yet to be undertaken).

4. Juvenile salmon and trout abundance

Salmon fry: Abundance estimates for salmon and trout fry (0+ fish) obtained from 5-minute timed electrofishing surveys are shown in Figs. 5 and 6, respectively. These are summarised for lower, middle and upper sections of the main Dee and tributaries (Ceiriog, Alwen and Tryweryn) broadly corresponding to the following reaches:

- Lower Dee: Bangor on Dee to Newbridge
- Middle Dee: Newbridge to Corwen
- Upper Dee: Corwen to Bala

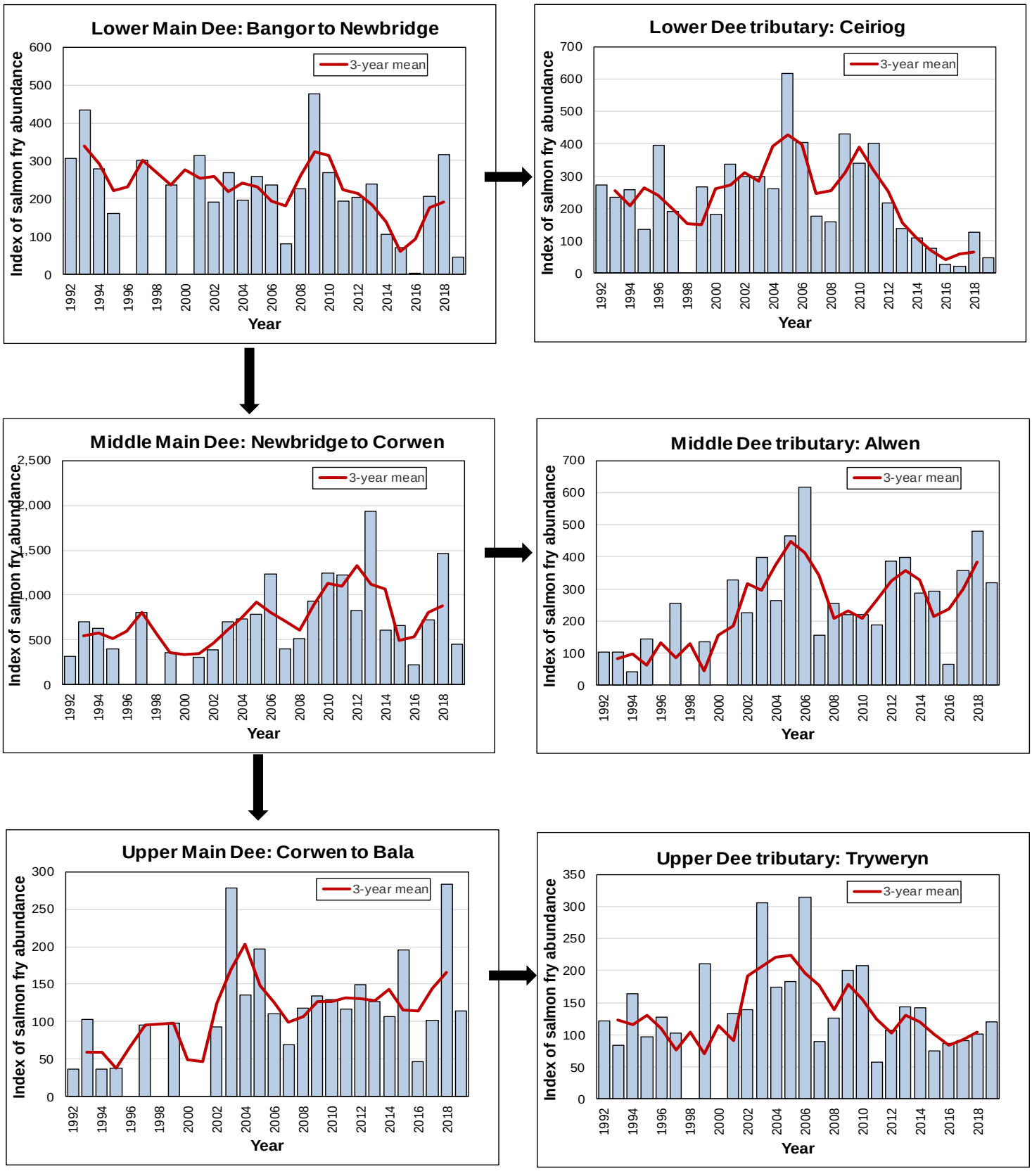
It is evident from Fig. 5 that salmon fry abundance estimates from the lower Dee have shown signs of marked decline since around 2010.

The most extreme example of this has been on the Ceiriog where the decline has been near continuous - from a 3-year mean 'abundance index' of 390 fry in 2010 to 66 in 2018.

Similar declines in this period have been apparent on the lower and middle main Dee, although in both cases there are signs of recovery in the last three years.

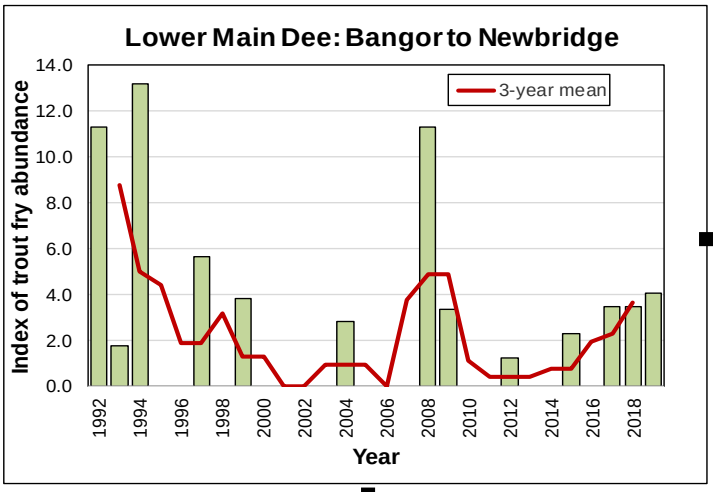
Other lower Dee tributaries (not shown here) have also shown marked declines in salmon fry abundance equivalent to that on the Ceiriog.

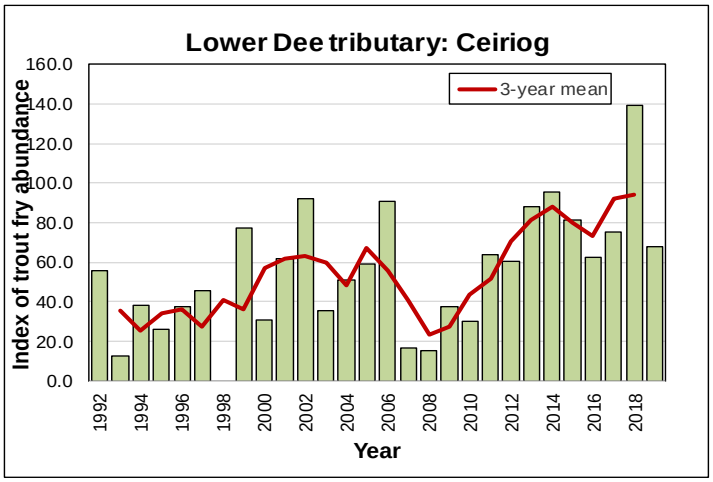
Fig. 5 Salmon fry abundance estimates from electrofishing surveys: Lower, middle and upper sections of the Dee and tributaries, 1992-2019

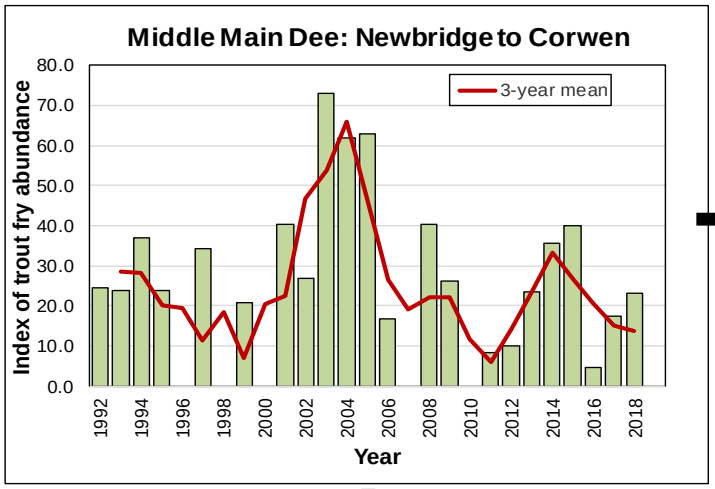


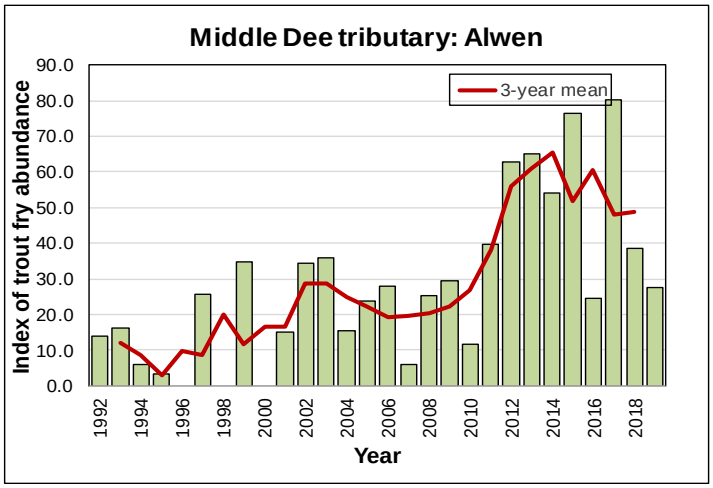
[Arrows indicate upstream direction]

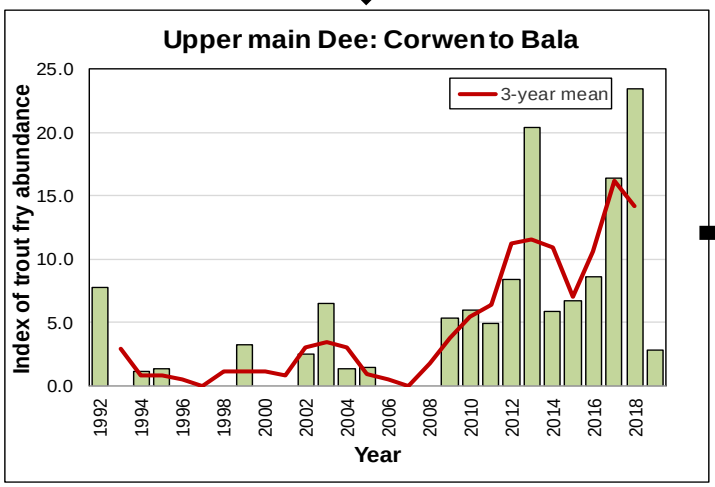
Fig. 6 Trout fry abundance estimates from electrofishing surveys: Lower, middle and upper sections of the Dee and tributaries, 1992-2019

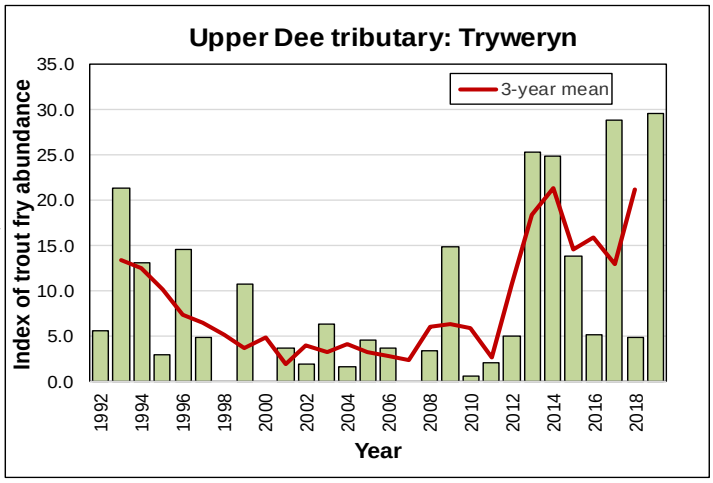












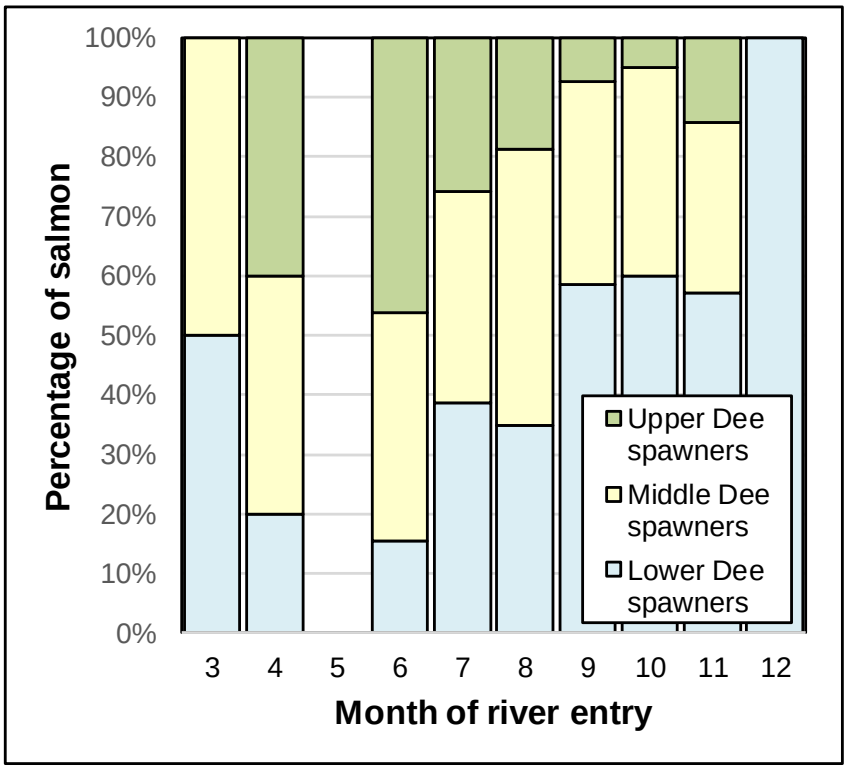
[Arrows indicate upstream direction]

Elsewhere on the Dee - in the middle and upper catchment - salmon fry abundance estimates have generally declined less steeply in the last decade than in the lower river (e.g. Tryweryn), or have remained relatively stable (e.g. upper main Dee), or have shown signs of improvement (e.g. Alwen)

This contrast in patterns of abundance between lower and upper river populations may relate to the decline in grilse numbers and the tendency for this run component (or at least the late summer/autumn entrant group to which most grilse belong) to spawn in the lower catchment.

At least that was the general picture of salmon spawner behaviour on the Dee established from a three-year tracking study in the early 1990s. Results from that study are shown in Fig. 7 below. This indicates, for example, that around 50% or more of salmon entering the Dee from September onward spawned in the lower river - a period when most entrants would be grilse. (In recent years, with the decline in grilse numbers, very few fish of any description now enter the Dee at Chester after mid-August.)

Fig. 7 Spawning distribution of radio-tagged salmon on the River Dee, 1991-1993 (sample size = 176)



Trout: Fig. 6 shows time-series of trout fry abundance estimates around the Dee catchment.

Few trout fry are captured in the main river, hence abundance estimates are more ‘patchy’ than for salmon. Throughout the length of the main river (lower to upper), as well as on the associated tributaries (i.e. Ceiriog, Alwen and Tryweryn), there is no sign of the downturn in abundance seen in salmon fry in the last decade.

In contrast, the common picture for trout fry is one of increasing numbers in recent years - a picture which is in-keeping with increased returns of sea trout at Chester over a similar period (see below).

Finally, the marked drop-off in juvenile recruitment in 2016 - following 'Storm Desmond' - appears a fairly consistent feature among the salmon fry abundance estimates on the Dee (Fig. 5), but is less evident among trout fry (Fig. 6).

Five-minute timed electrofishing sampling of juvenile salmonids at a main Dee site.

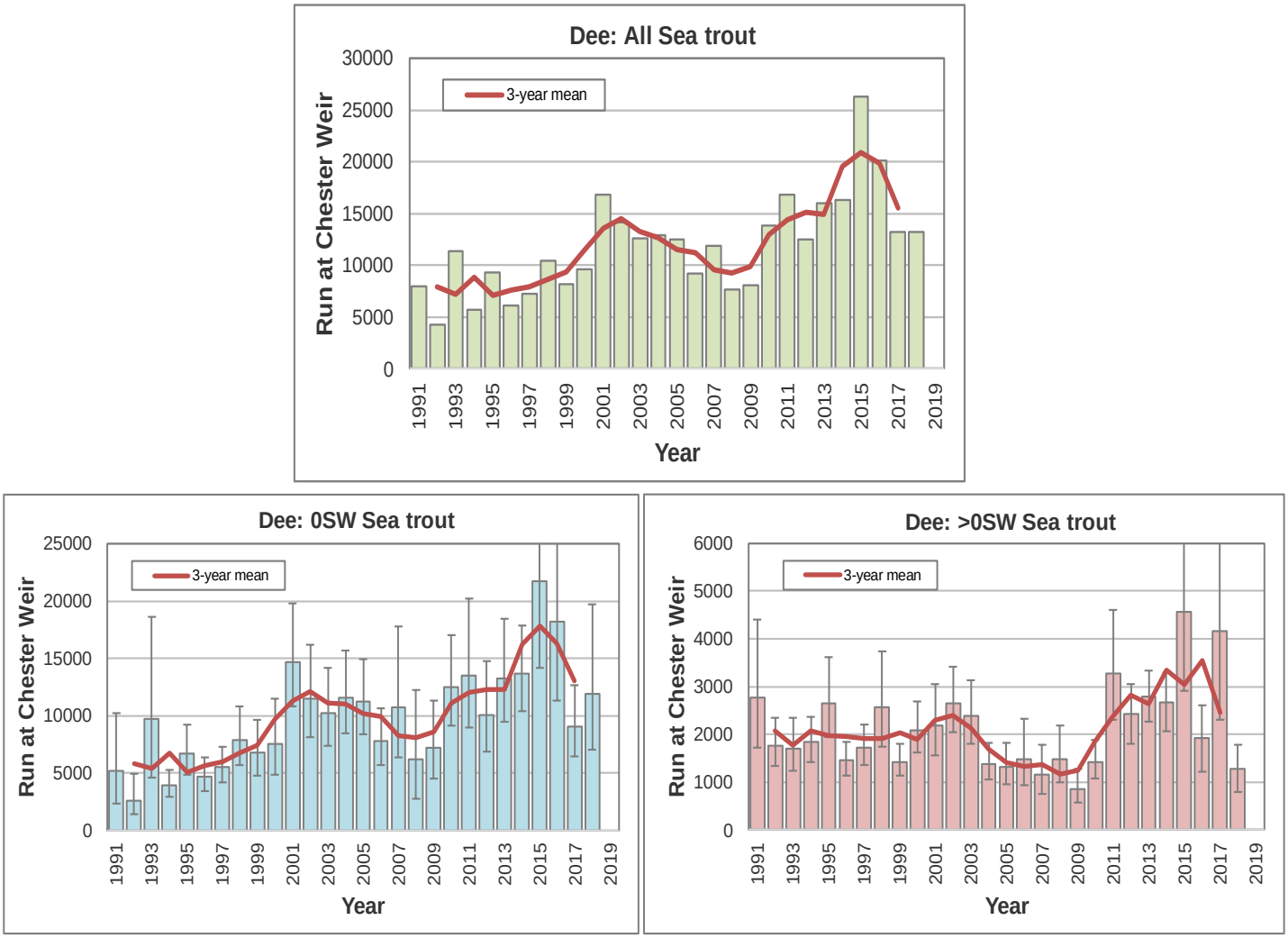
5. Dee Sea Trout in 2019

Run size: As described in Section 2, run estimates for sea trout on the Dee rely on the recapture of tagged 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. The provisional estimate for whitling in 2018 was 11,894 - above the long-term average return of 9,749 fish. Numbers of older sea trout were down to 1,281 in 2018 - below the long-term average of 2,153 (Fig. 8).

In 2019, a total of 2,379 0SW and 177 >0SW sea trout were captured at Chester trap. The catch total for >0SW was well down on previous years, but would have been influenced by poor trap efficiency during an unusually wet early summer when most larger sea trout enter the Dee.

Fig. 8 Annual run estimates for sea trout at Chester Weir, 1991-2018
(error bars indicate 95% confidence intervals)



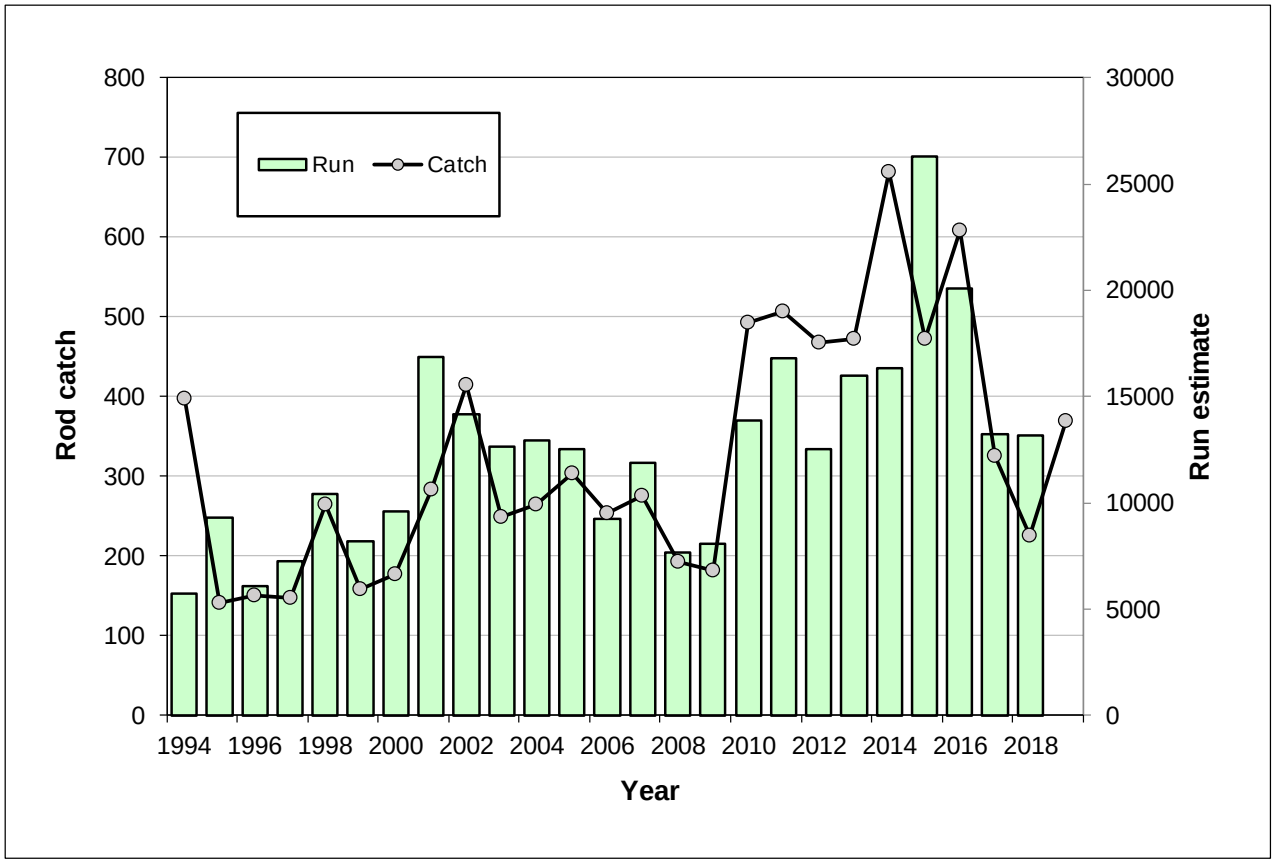
Rod catch: Provisional sea trout rod catch figures for the Dee in 2019 stand at 370 fish - above the long-term average catch of 324 fish. As with salmon, there is strong correspondence between declared rod catches of sea trout on the Dee and estimates obtained from the tagging and recapture programme at Chester trap (Fig. 9).

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 2018.

Fig. 9 Sea trout rod catch & run estimates at Chester Weir 1991-2019



6. Other Developments.

Byelaw proposals: New 'All Wales' and 'Cross-Border (Wye and Dee) fishery byelaws are now in place in Wales.

The byelaws will run for 10 years from January 2020, and mean all salmon caught by net and rod fisheries must be released alive with the minimum of injury and delay.

The details of the angling byelaws for the Dee and all other rivers in Wales can be found on the NRW website at:

https://naturalresources.wales/guidance-and-advice/business-sectors/fisheries/angling-byelaws/?lang=en

Dee alternative mitigation

Afon Hafhesp: In early 2016, a habitat scheme was undertaken on the Afon Hafhesp in the upper Dee catchment. The land around the Hafhesp had been heavily grazed over the years and with a change in farming policy to dairy, it was identified as a priority tributary to protect and improve. The riverside corridor was fenced off and a bridge installed to remove all livestock and farm vehicles from the watercourse. This enabled riparian vegetation to re-establish and aimed to reduce silt deposition. An electrofishing survey in summer 2019 produced very encouraging results compared to previous

years. When last surveyed in 2013, no salmon fry were recorded, but last year numbers were comparable with 2001 figures. There was also a 3-fold increase in juvenile trout abundance. Numbers of salmon parr and larger trout had also greatly increased - a clear indication of the improvement in the habitat quality and availability.

Photos taken in 2015 & 2019 (Gethin Morris).

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
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