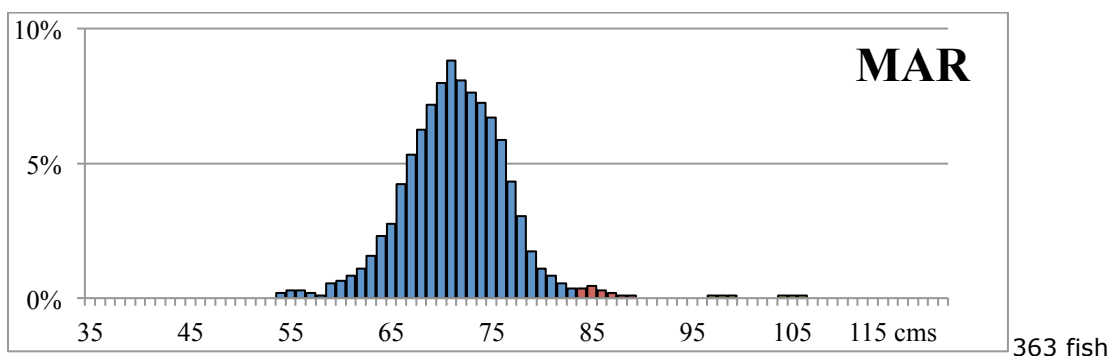
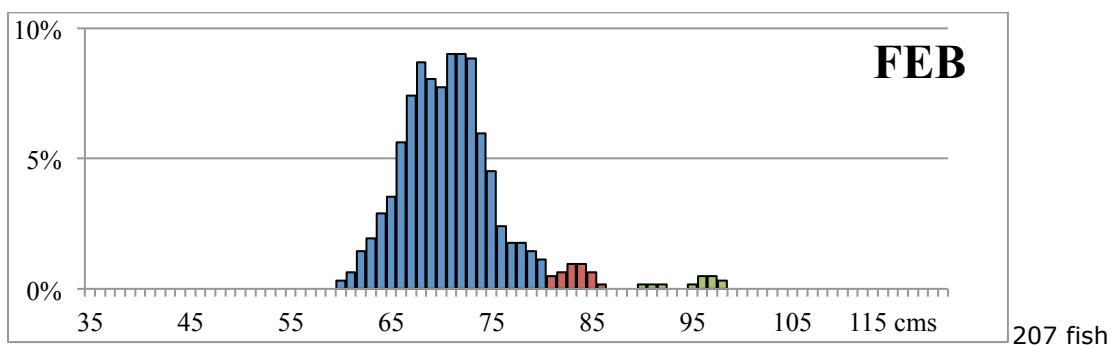
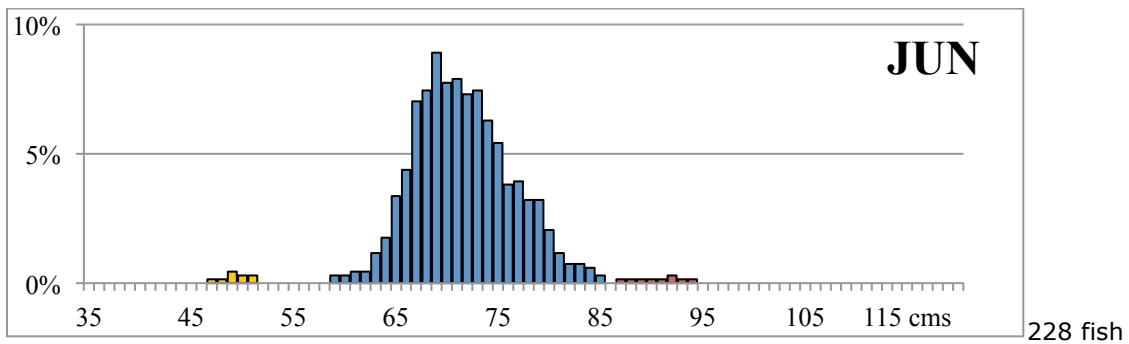
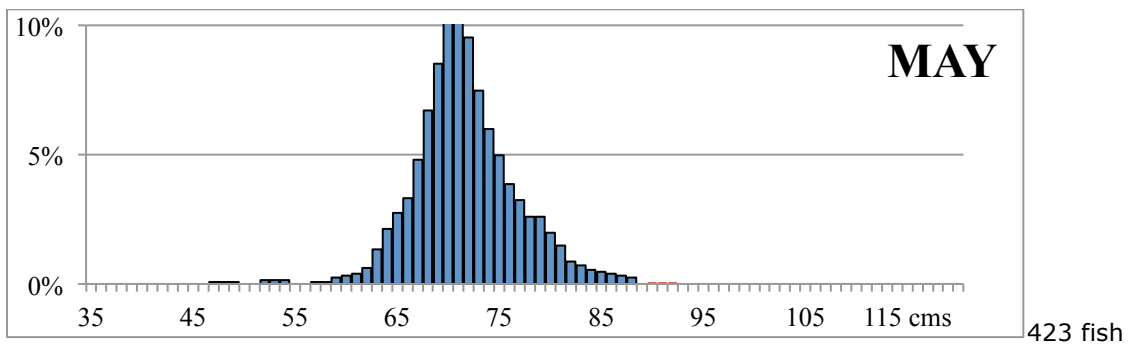
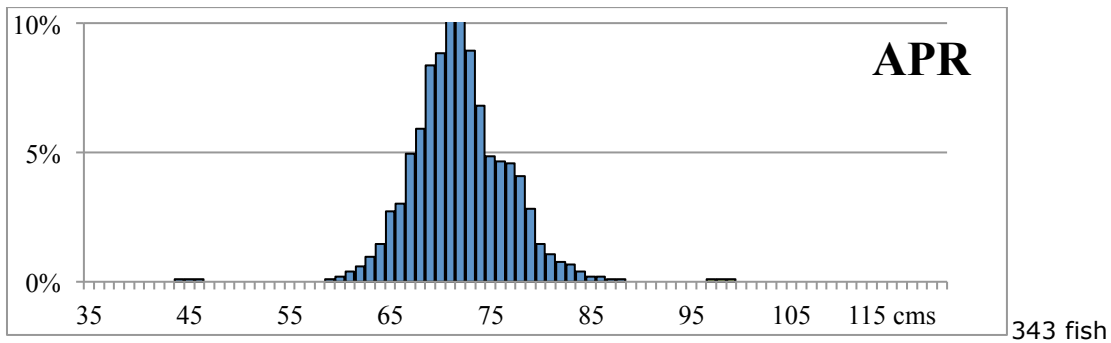




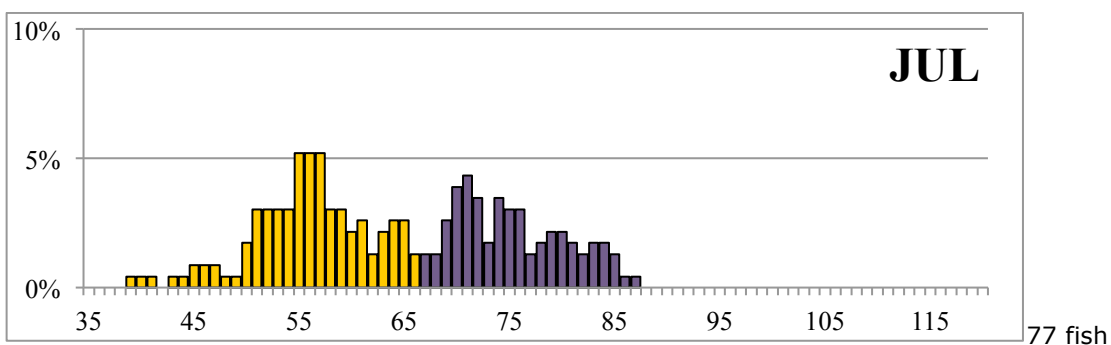
Temporal segregation of the different run timing stocks of Tweed Salmon in the rod fishery

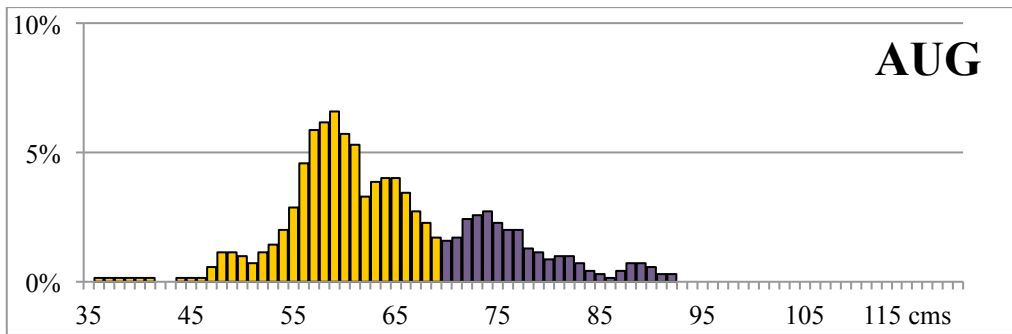
1. Although the different runs of Tweed Salmon and grilse – Spring, Summer and Autumn – come in at different times of year, they mix in the main river as they move more slowly up to their home areas.
2. This does not mean however, that the rod fishery catches a mix of different stocks throughout the season as is shown very clearly in the sizes (lengths) of fish caught in the main channel through the fishing season. The graphs below are for fish killed and measured at seven fisheries in all the zones of the river from 1991-95, before Catch and Release for Spring Salmon started in 1998 and before high rates of release of Autumn fish became standard practice. This means that the sample measured fully reflected the types of fish being caught, which later sampling does not.
3. The graphs show the percentage of the total sample for the month made up by each 1cm size of fish* and it can be seen how the catches from February to June are almost entirely made up of fish ranging from 60 to 80cms in size (blue columns) – these are the standard, Tweed Spring Salmon of around 6 to 12lbs (commonest size 8lbs) which have been two years out at sea before returning (2 Sea-winters, 2SW). They are defined as being Spring Salmon by the fact that there is slower, winter, growth at the edge of their scales. The small group a bit larger than these, best seen in the February graph (red columns) are repeat spawners that survived the previous season's spawning and have returned a little larger for a second time. The group of larger fish, around 90cms, (green columns) are three Sea-winter fish (3SW) that have spent an additional year at sea.



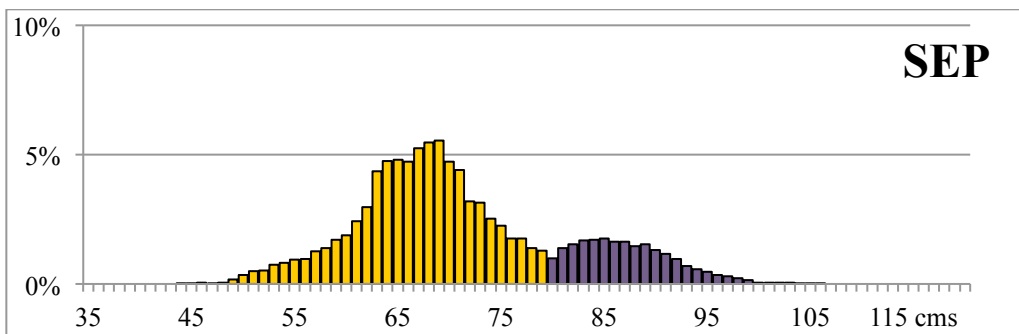


4. These 2SW Spring Salmon, with a few repeat spawners and some 3SW fish dominate the catches till July, when everything changes as a new age class comes in to the river – Grilse (one sea-winter fish, 1SW) [yellow columns]. The first few of these actually appear in the catches in June at around 50cms, but they don't appear in numbers till July. A new class of Salmon also appears in July, Summer Salmon (2SW+) which have put some growth on after their last winter in the sea and so are generally larger than Spring Salmon (purple columns).

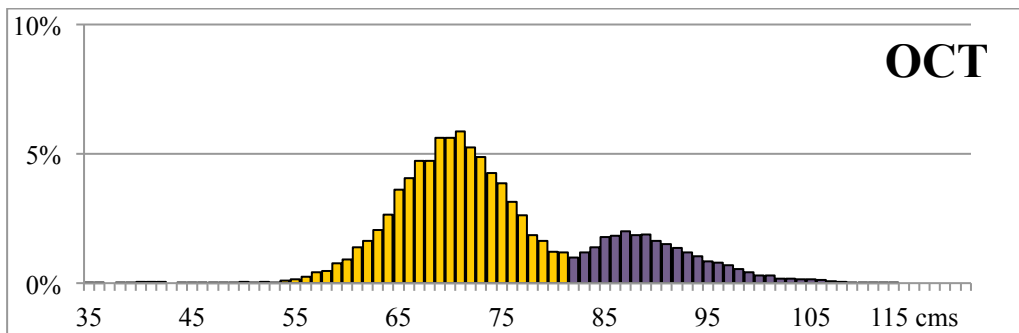




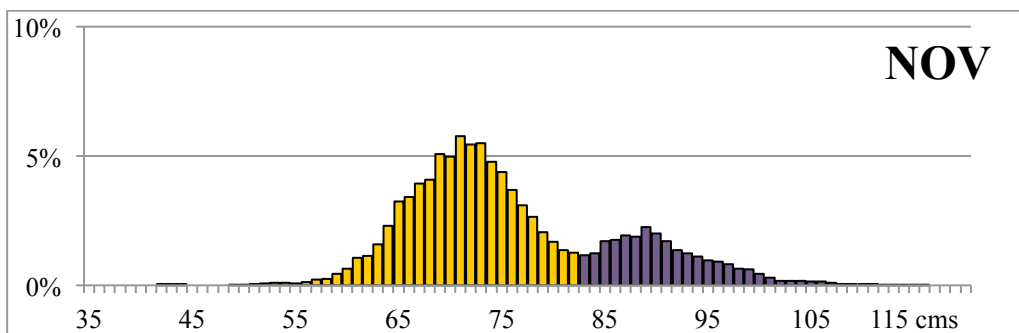
233 fish



1137 fish



2197 fish

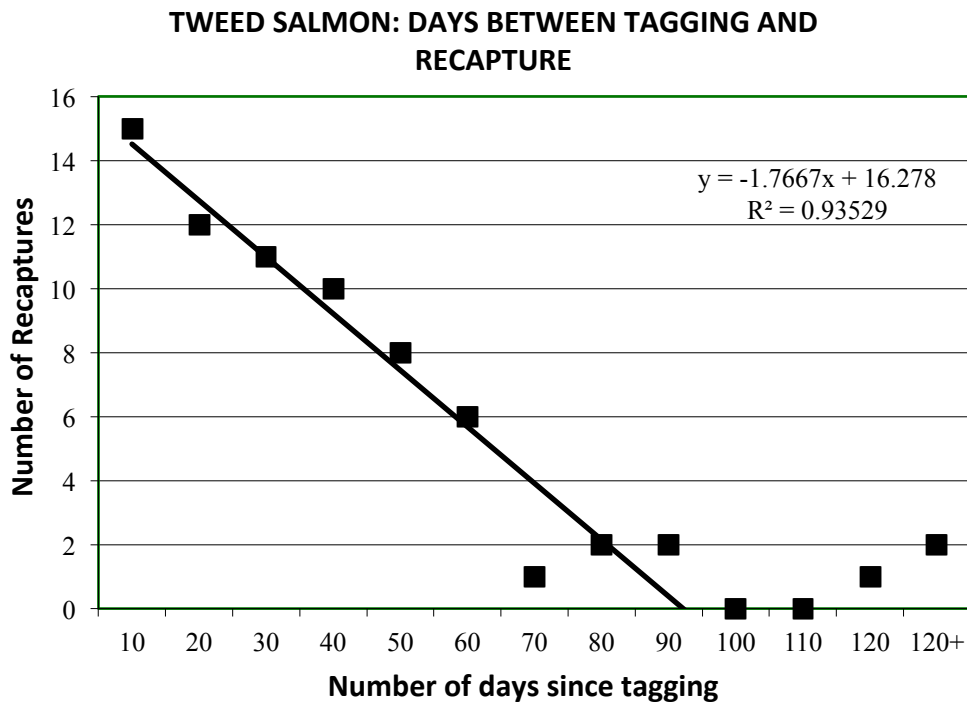


1629 fish

5. These two classes of fish then dominate the catches for the rest of the season. Even fish up to 40lbs or so can still be two sea-winter Summer Salmon (2SW+), but with a lot more growth than usual put on after their last winter. Three sea-winter Summer fish would be very large indeed.
6. The reason why the changing pattern of size / age classes coming in through the season is so clearly reflected in the angling catches is because the "catchability" of fish declines rapidly after they enter fresh water: the longer in the river, the less likely a fish is to be caught.



7. That this is the case is demonstrated by the recaptures of Salmon and grilse tagged at the bottom of the river and recaptured by anglers upstream. About half are caught within a month of being tagged, and 90% within two months because, as the graph below shows, the “catchability” of Salmon starts to decline steeply once it enters the river.

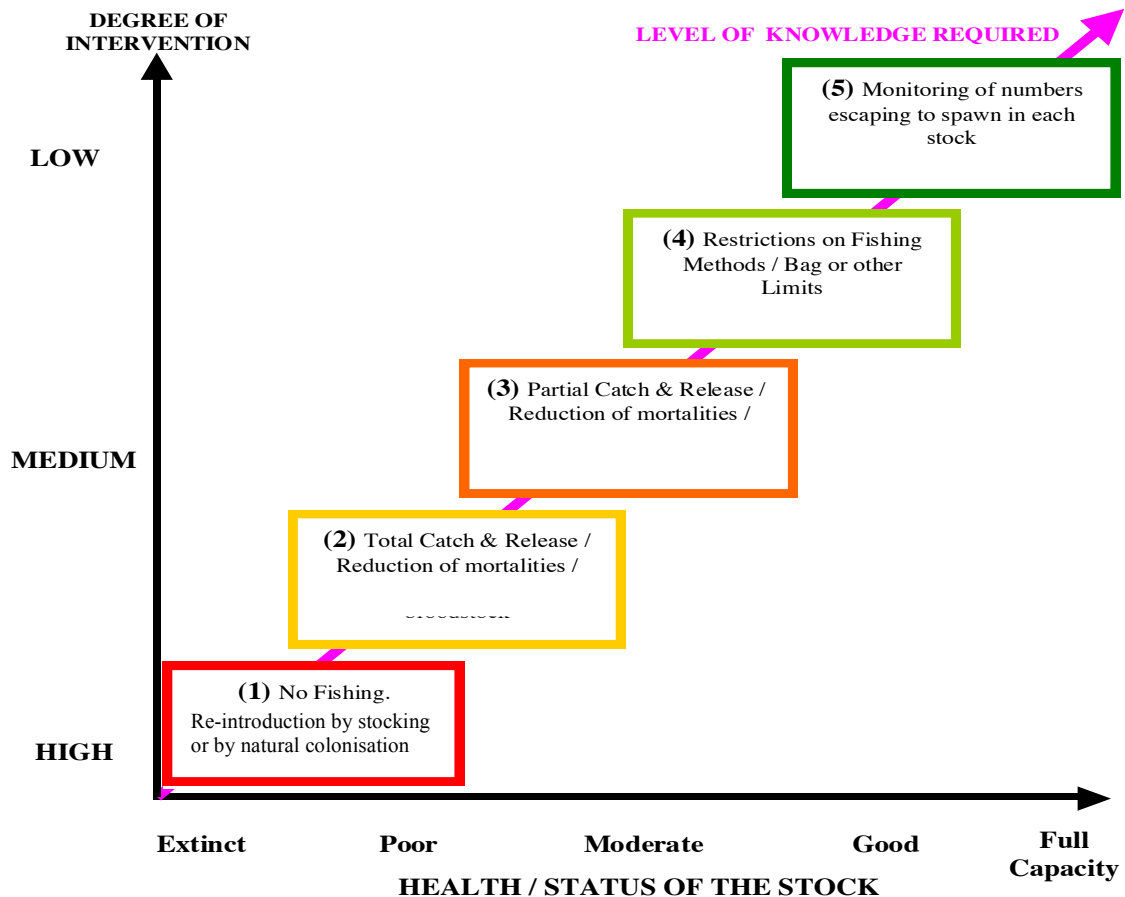


(70 angling recaptures from 1219 Floy and Radio-tagged Salmon 1994-2014)

8. The management implications of this decline in catchability in fresh water are:-
- a) To maintain the ten-month long Tweed fishing season, there have to be significant numbers of fresh fish coming in to the river throughout the season. If a large proportion of a run enters the river at one time, then there will be a shortage of catchable fish within four to six weeks, regardless of the total number of fish in the river (this is what appears to have happened in 2011 with a very large run in early Autumn that went stale in the river and became largely uncatchable).
 - b) The different run-timing stocks can be regulated separately, despite being mixed together in the river, as fish that have been more than two months in fresh water are very unlikely to be caught. Such separate regulation is re-inforced by the fact that Prawn fishing is not allowed on the Tweed (it was banned in 1988) and the legal requirement to return “unclean and unseasonable” fish. The very high rate of voluntary “Catch and Release” (c. 50%) that now prevails in the Autumn is a further re-inforcement of this capacity for stock-by-stock regulation.
 - c) This opportunity to manage stocks separately if they are separated by time is recognised in the 2013 report of the ICES Working Group on North Atlantic Salmon (WGNAS) in which it is stated “*It would also be possible to use information on the composition of the catch in the mixed stock fishery and its variability over time to set a harvest limit that would still ensure that each stock meets its management objective.*” In the case of the Tweed, this is done by having full Catch and Release for the period when the weak Spring Salmon stock is catchable in the rod fishery. The June and July graphs in (3) and (4) above show how complete the changeover is between those months in the sizes – and therefore types – of the fish being caught.



9. There are five different "Management Levels" recognised for Tweed Salmon management. These "levels" are the packages of regulations and management actions deemed appropriate for different strengths of stocks as shown in the diagram below:



10. The stronger the stock, the less management intervention is required. A very weak stock requires a high level of intervention, such as a ban on fishing or re-introduction from elsewhere, while a very strong stock just requires good monitoring to ensure it stays in good condition. On the Tweed, Spring Salmon are managed at Level 2, Total Catch and Release while Autumn Salmon are managed at Level 4, with some precautionary restrictions on fishing methods. Such differential management of stocks within the same river is what is made possible by the temporal segregation of stocks within the rod fishery, as outlined above.

* The lengths data has been "smoothed". This is a statistical technique in which the data for each year is averaged with the data for the years before and after. This smooths out random variation and allows any underlying pattern to become more obvious.