Barbel scale ana

An introduction from Pete Reading:

A funded Research & Conservation Project Report

The following scientific report produced for the Society by **Dr Robert Britton** of Bournemouth University is the briefer of the two reports he has now completed for us. (See Barbel Fisher 32).

Members will note that the reports are, by definition, written in precise and detailed scientific language, but I thought I would reproduce the shorter one for you to demonstrate the depth and detail that goes into such research. The conclusions may seem brief too, but scientists are trained not to be too speculative when producing proper reports!

The accepted procedure is to compare length with age, and never to use the weight of the fish in such reports, but the data has been adjusted to take into account the variations that occur at different times of the year.

In general, a fish reaches double figures at around 70cm in my experience, but length/weight tables are fairly meaningless for barbel, and indeed most cyprinids, due to seasonal variations

The shorter report is based on scales collected from the Teme, Kennet, and Hampshire Avon in the last season. The longer report uses data from national scale archives collected over many years by the EA.

The process is still in its early stages, but one thing that we can reasonably gather from the data is that many of our barbel are far older than we might expect, and that some populations are composed of quite old specimens. Some Teme fish of six or seven pounds may be twenty years old, and close to the end of their lives.

This does not always mean that the younger fish are not there, of course, as the next generation may be occupying habitat that we do not exploit by angling, and the capture of very small barbel by rod and line is a comparative rarity on most rivers.

The Hampshire Avon still produces the highest growth rate, and this fact is reinforced in the more detailed report, that compares the growth rates of well over a thousand barbel from twenty two UK rivers. It is also of interest that the cleanest rivers produce the best growth rates, and the rivers of lowest water quality produce good roach growth but worst barbel growth.

We are intending to examine further scale samples in the coming season, and extend the analysis to include the Trent, as well as a bank of historical scale samples from the Hampshire Avon kindly donated by Ray Walton.

The reading of the scales is a skilled task, but Dr. Britton is a top expert, and is able to see the annual growth checks using a highly experienced eye; the annulus is not easy to see on the picture reproduced within the report.

We are also looking at a project that uses stable isotope analysis to gain information on barbel diet; it is possible to take small samples from scales, and determine, for example, how much of their diet is made up of crayfish, or angler bait. This method has been used with salmon, and also more recently with chub, and could produce some interesting results.

If you have any questions related to the reports, please send them to me, and I will ask Dr. Britton to answer them, and we can then publish the answers in the next issue of Barbel Fisher.

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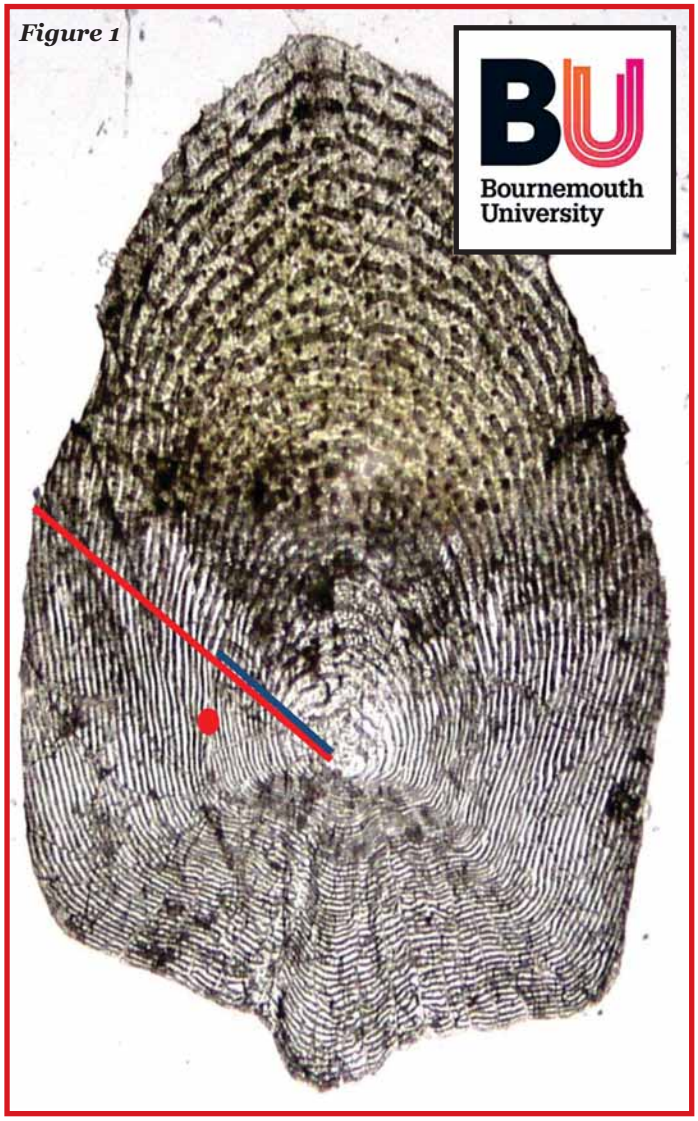

Figure 1. An image of a barbel scale showing an annulus (red circle), the scale radius (red line) and the distance to the first annulus (blue line)

Growth rates of barbel *(barbus barbus)* from three rivers in England – A report on the scales collected by the Barbel Society

1. Introduction

The literature review of Britton & Pegg (2011) on the ecology of European barbel revealed there was a lack of knowledge on the growth rates and recruitment success of barbel in rivers in England. This resulted in a

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research theme on this topic that was to use two separate approaches:
(i) Compilation of all available Environment Agency data on barbel age and growth rates and undertake a meta-analysis to identify relationships in barbel age and growth rates with environmental parameters such as water chemistry, flow rates and temperature;
(ii) Collection of scales from barbel via angler captures from four rivers in England to provide a more comprehensive insight into the age and growth of these fish at specific locations.

This report covers (ii) and details the age and growth rates of barbel for three rivers: Hampshire Avon, River Teme and the River Kennet. Scales have yet to be provided from the fourth river (Trent).

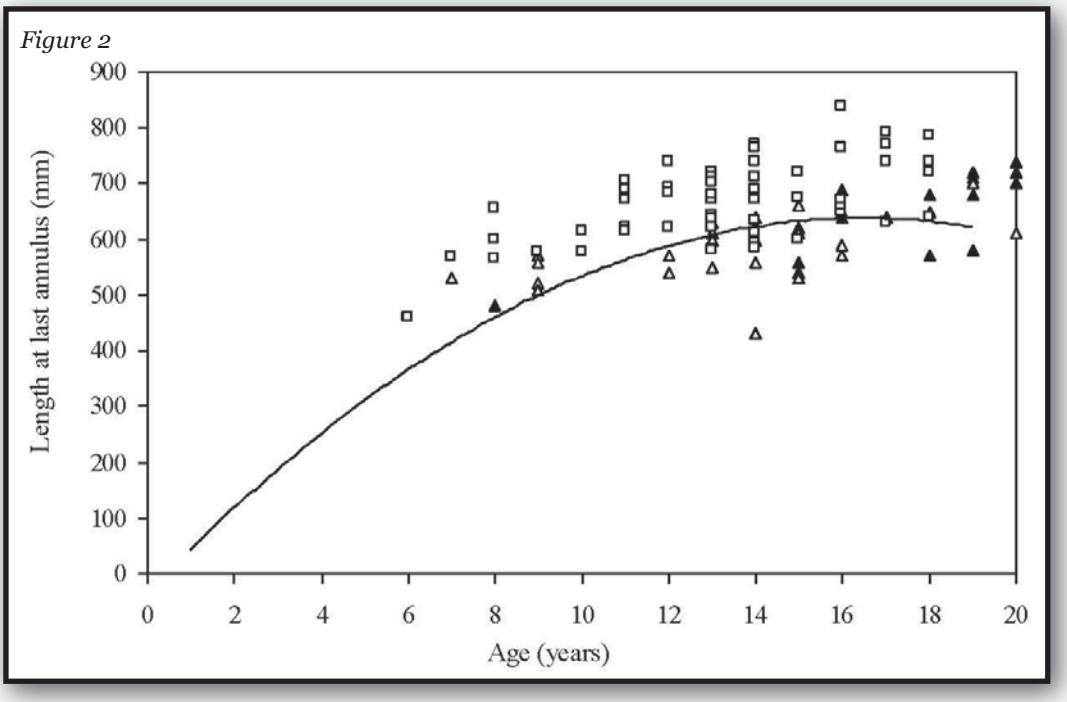


Figure 2. Back-calculated length at last annulus from barbel scales provided by the Barbel Society from the Rivers Kennet (Δ), Teme (▲) and Hampshire Avon (□) (i.e. the observed length at age data). The solid line is the relationship according to polynomial regression of the age and length of 1138 barbel from across 22 rivers in England (i.e. the predicted length at age of barbel).

2. Methodology
The scales were viewed under a projecting microscope from which an age estimate was derived before the measurements were taken of (a) scale radius (centre of scale to scale edge along a particular gradient); and (b) the distance from the centre of the scale to the last annulus (annual growth check) along the same gradient (Fig. 1). This enabled use of a back-calculation equation to provide the length of the fish at its last birthday, removing any effect of the season when it was caught (i.e. during the fish growth season, generally May to October). The back-calculated lengths at each age of each individual were not calculated as the multiple use of length-at-age data from single fish in statistical tests violates many of the underlying assumptions of those tests, i.e. the test results become invalid.

To compare the growth of the barbel from the Rivers Kennet, Teme and Hampshire Avon, the length at age data of their captured fish (i.e. the observed data) were compared against their predicted length at age (i.e. the predicted data). The predicted lengths at age were derived from the database from Approach (i) outlined in the Introduction that provided the relationship between age and length for 1138 barbel from 22 rivers (Fig. 2). By then comparing the observed against the predicted data, the difference between the two values were determined – their residual value. Once the residual values for each fish by age in the three rivers had been determined, they were transformed into standardised residuals [(residual – mean residual value) / standard deviation of residuals]. This step provided the residual data around the figure 0, where a positive value represented faster growth than the predicted, and a negative value represented slower growth.

For each river (Teme, Kennet and Hampshire Avon), their mean residuals were determined along with their standard deviation (adjusted in a general linear model for the any effect of age). This provided an output that revealed whether their growth was fast, similar or slower than expected in a river in England.

> "This provided an output that revealed whether their growth was fast, similar or slower than expected in a river in England"

3. Results
It was apparent from the ageing data that the samples of barbel scales were biased according to larger fish; there were no fish aged that were under 40 cm or age 5+ years (Fig. 2). Fish were present in the samples to at least 22 years old, showing the fish in these rivers were capable of relatively long life-spans.

The length at age plot

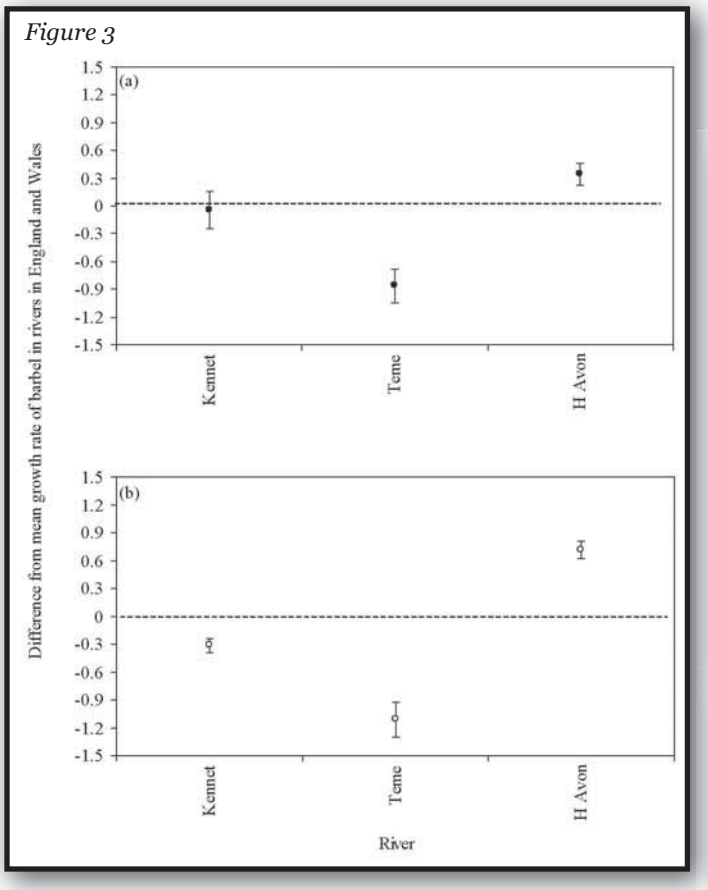


Figure 3. (a) Mean standardised residuals for barbel growth in the Rivers Kennet, Teme and Hampshire Avon using scales collected by the Barbel Society, where values > 0 indicates faster growth than predicted and < 0 indicates slower growth than predicted. Error bars show the variance in the data according to 95% confidence limits. The dashed line denotes the predicted growth value. (b) The plot shows the same variables as (a), except the values were derived from Environment Agency data (from (i) described in the Introduction).

revealed considerable variation in the lengths at age (i.e. the observed data) within and between each river, and these values also showed considerable differences from the predicted length at age data (Fig. 2). The use of the standardised residuals removed the effects of age from the data and revealed that barbel in the River Teme, despite being capable of attaining ages of 20 years old, were very slow growing when compared to the other two rivers and compared to the predicted values for barbel in rivers in England and Wales (Fig. 3a). For the River Kennet, growth was not significantly different from their predicted values, with fish capable living for over 20 years (Fig. 2, 3a).

For the Hampshire Avon, fish were both significantly faster growing than predicted and capable of living for at least 18 years (Fig. 2, 3a). These growth patterns for each river were very similar to those from the Environment Agency data described in (i) in the Introduction (Fig. 3b).

4. Conclusions

The scales collected by the Barbel Society from these three rivers were extremely useful in providing valuable insights into barbel ecology in English rivers. They revealed growth was extremely variable between the 3 rivers with, for example, fish in Hampshire Avon growing much faster than the River Teme. In all of these rivers, fish were capable of long life-spans, with ages of > 20 years being encountered in both the Kennet and Teme. Outputs were also consistent with those from Environment Agency data for the three rivers concerned.

The next step is to complete the meta-analysis described in the Introduction so that the environmental

Hampshire Avon barbel scales: An overview

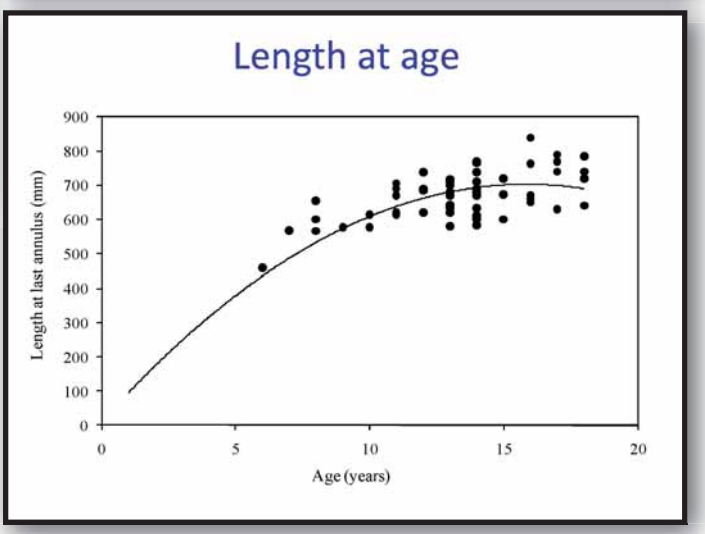
Raw data

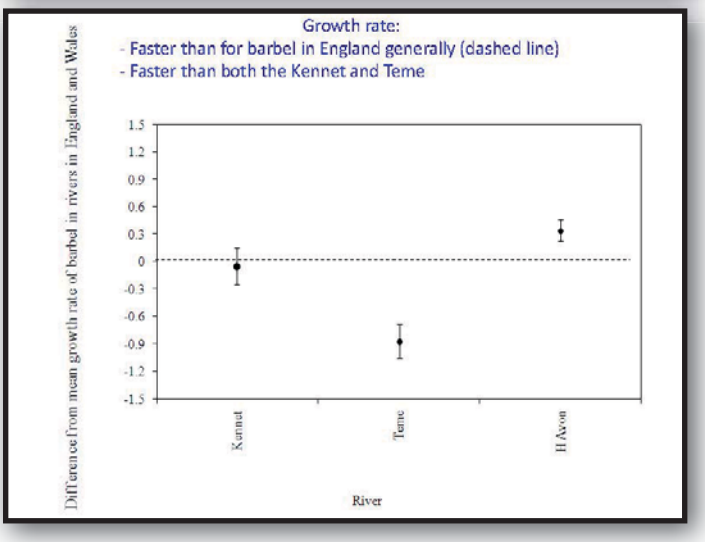
Length (mm)	Age (years)
460	6
566	8
567	7
577	9
577	10
580	13
584	14
600	14
600	15
600	8
609	14
610	14
611	14
611	14
615	11
615	10
620	11
620	13
621	12
630	17
633	14
634	13

Length (mm)	Age (years)
636	13
640	13
640	13
641	18
641	13
650	16
654	8
660	16
660	16
670	11
670	13
670	14
672	16
673	15
680	14
681	13
684	12
690	14
690	11
691	12
700	13
700	13

Length (mm)	Age (years)
706	11
710	14
710	13
710	14
719	13
720	15
720	18
739	12
740	14
740	17
740	17
740	18
764	16
765	14
770	17
770	14
770	14
784	18
790	17
839	16

Fish present between age 6 and 18 years old





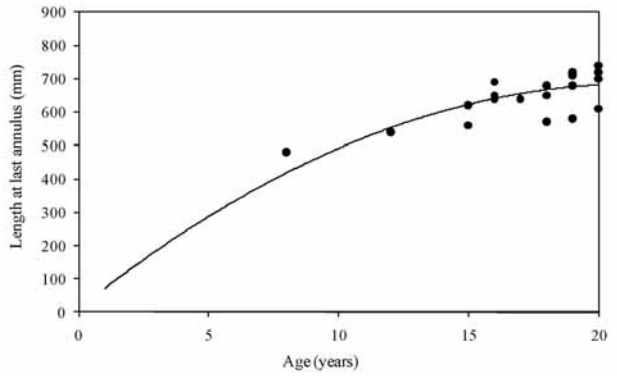
River Kennet barbel scales: An overview

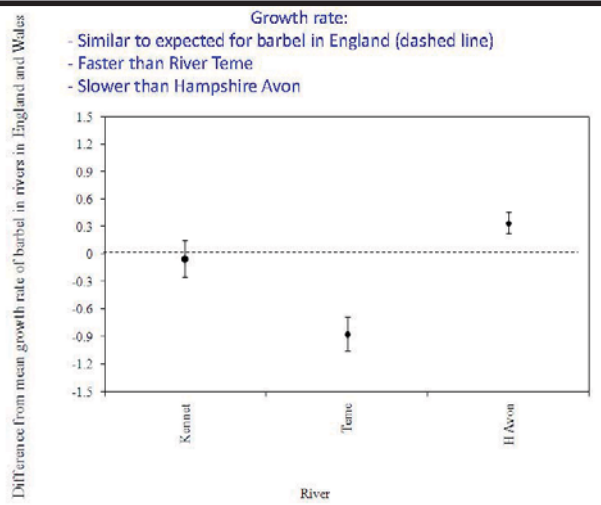
Raw data

Fish present between age 8 and 22 years old

Length (mm)	Age (years)
480	8
540	12
620	15
560	15
650	16
650	16
690	16
640	16
640	16
640	17
650	18
680	18
570	18
680	19
720	19
710	19
580	19
710	19
700	20
740	20
720	20
700	20
610	20
650	21
780	21
690	22

Length at age





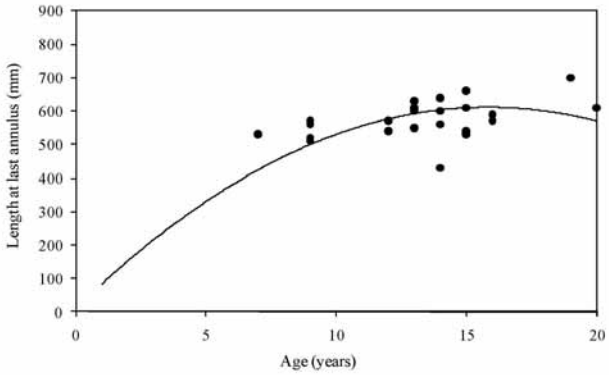
River Teme barbel scales: An overview

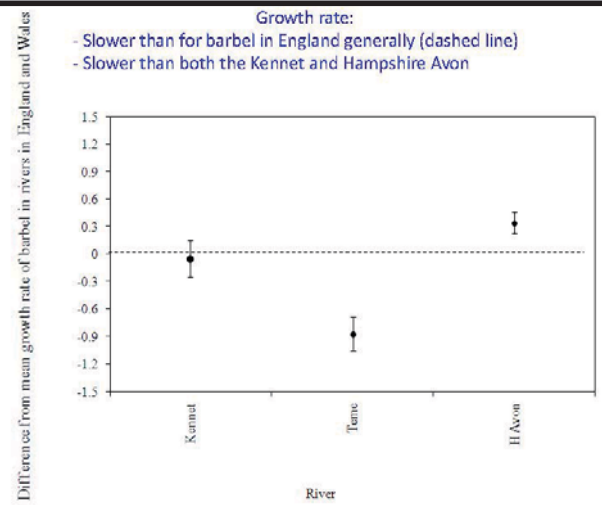
Raw data

Fish present between age 7 and 20 years old

Length (mm)	Age (years)
430	14
510	9
520	9
530	15
530	7
540	12
540	15
550	13
560	9
560	14
570	9
570	12
570	16
590	16
600	13
600	14
610	13
610	13
610	15
610	20
630	13
640	14
660	15
700	19

Length at age





drivers of these differences in growth patterns may be determined for these three rivers and barbel populations in England and Wales more generally.

5. References

Britton JR & Pegg J (2011) Ecology of European barbel *Barbus barbus*: implications for river, fishery and conservation management. *Reviews in Fisheries Science* 19, 321-330.