River Esk (Yorkshire) Tideway Byelaw Report

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Note unless identified separately, the term salmon includes salmon and grilse

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1. Executive Summary

During the 1970s and 80s salmon and sea trout catches on the River Esk declined markedly. This was in contrast to the patterns of salmon catches on other North East rivers

The declines were linked to the pressure from uncontrolled fishing in the tideway, where the fish are very vulnerable as they migrate upstream, and, after a Public Inquiry, the Esk Tideway Byelaw was passed in 1987 in order to protect the stocks of migratory salmonids

A River Esk Tideway Byelaw has been in force continually since 1987. It was renewed in 1997 with an amendment to improve its effectiveness and was last renewed in the same form in 2002. It will expire in February 2012 unless renewed again.

The data examined in this report show that there have been improvements in the stocks of salmon and sea trout returning to the River Esk during the period the byelaw has been in force which differ and are more significant than those seen in other north east rivers.

However, continued improvements in the population of salmon are still required for the river to meet its identified management target as the stock is currently considered to be “Probably at Risk”. Catches of sea trout appear healthier though these too are still below the level of “Not at Risk”

The byelaw has provided a clear, powerful and efficient regulatory regime for the protection of fish running through the tideway supporting their recovery.

The continued protection of the byelaw is required:

- to support the continued recovery of resilient salmon and sea trout stocks, the achievement of Good Ecological Status under Water Framework Directive and compliance with conservation targets;

- to complement other legislation including the North East Net Limitation Order; and Salmon Byelaws for the protection of these stocks

- to complement environmental measures (e.g. habitat improvements) supporting the recovery of the salmon population in the River Esk.

The Environment Agency proposes to remake the River Esk (Yorkshire) Tideway Byelaw in its current form which would continue the prohibition of fishing for all fish between Ruswarp Weir and Eskside Wharf but allowing rod fishing for sea fish during the daytime.

2. Introduction

2.1 Purpose

This document presents the case for renewing the byelaw which prevents fishing in the tideway of the River Esk (Yorkshire) in order to protect the salmon and migratory trout (sea trout) runs, and to support the restoration of their populations.

The information presented shows the current status of populations of salmon and sea trout, and how they have changed over the life of the Esk byelaw.

The byelaw has been in force since 1987 but will expire in February 2012 unless renewed. The remaking of the byelaw has received widespread support amongst local interests and was endorsed by the Yorkshire and North East Regional Fisheries Advisory Committee in February 2010 (minute enclosed - Appendix 6).

The Environment Agency has the power to make the byelaw under s210 and Schedule 25 of the Water Resources Act 1991

2.2 Background

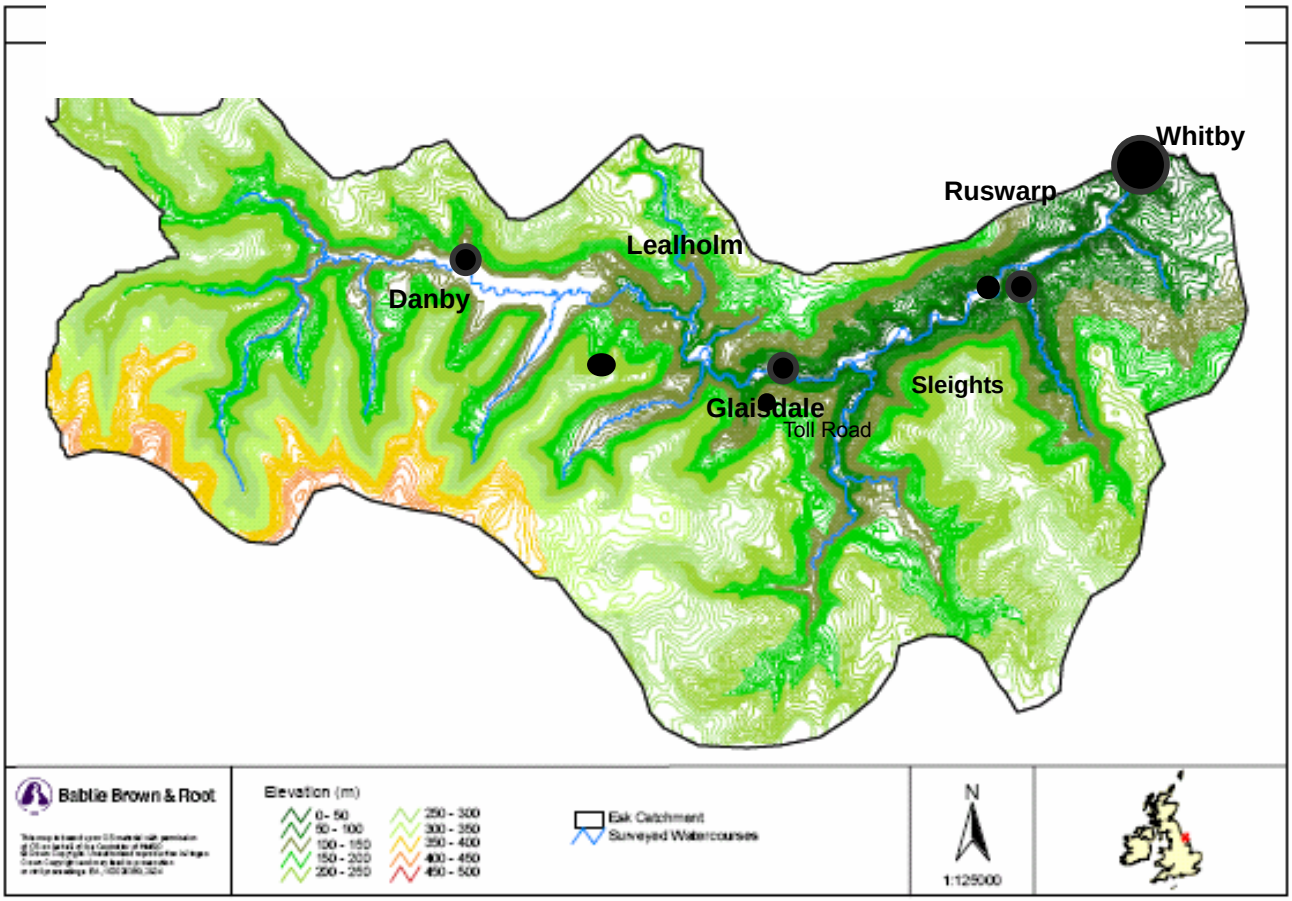
The River Esk is currently the only river in Yorkshire categorised as a principal salmon river, where salmon data is reported annually in national and international reports.

It has long been valued for its salmon and sea trout and the quantity of fish caught and their individual large size, has been exceptional for such a small river.

We are proposing renewal of the tideway byelaw because of continuing concern for the viability and future of these stocks in a particularly sensitive stretch of their spawning migration.

3. Description of The River Esk

The River Esk rises on the moorlands of the North York Moors National Park only 42 km from the sea at an altitude of between 300 and 400 metres. It then flows east to meet the sea at Whitby draining an area of 362 sq km. The tidal stretch is limited by Ruswarp weir, just 3.5 km from the sea. Average rainfall within the catchment is 950mm inland , with 650mm on the coast (Map 1).

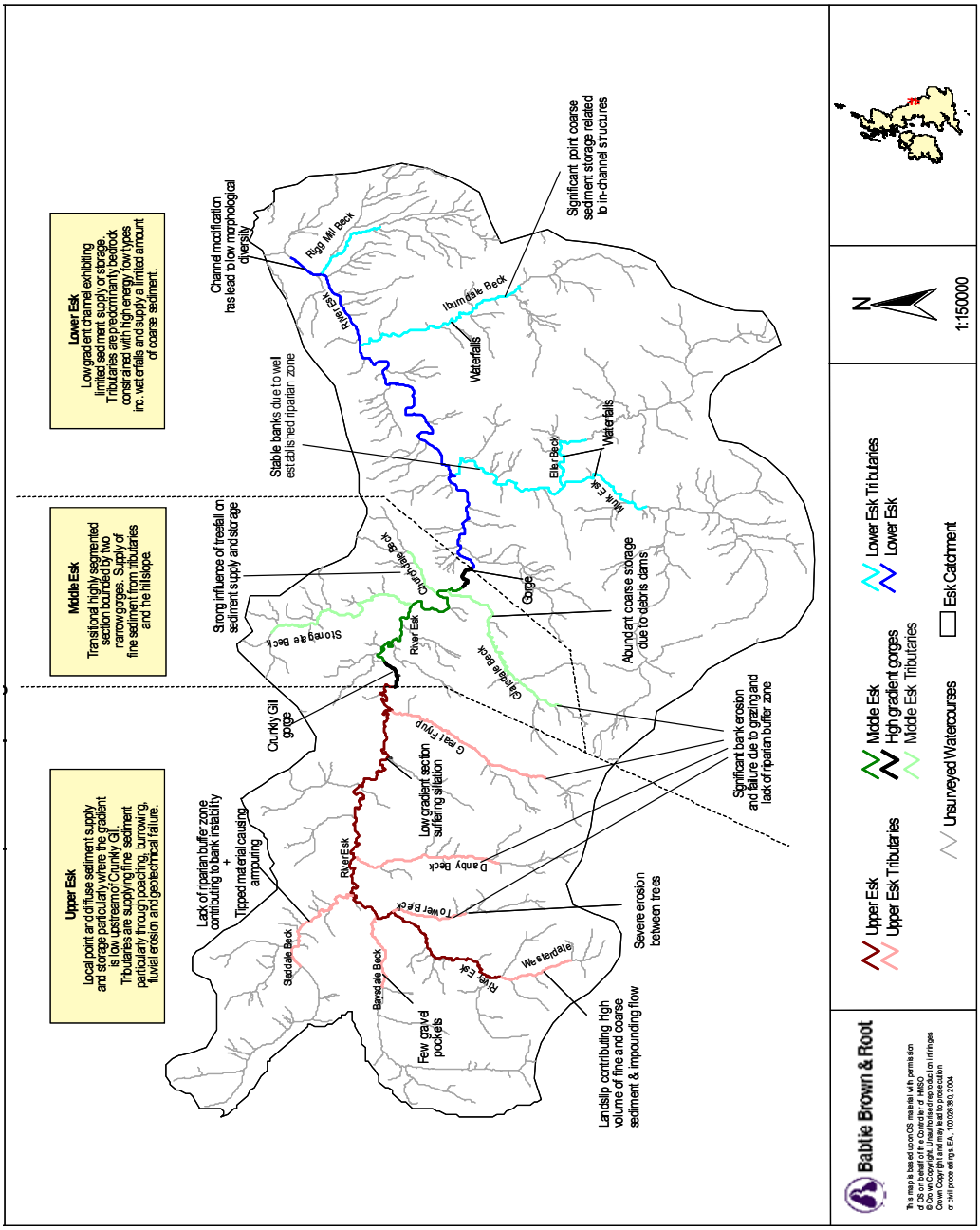


Map 1. Topography in the Esk catchment. (From Catchment Fluvial Geomorphological Audit of the Esk Catchment 2004, Environment Agency/Babtie, Brown and Root).

Throughout its length the River Esk flows through a narrow valley cut into the soft shale of the Jurassic rocks of the North York moors. The Esk's steep sided valleys mean that river levels rise quickly following rainfall. Normal flows at Sleights (5.6 km from the sea) are below five cubic metres per second (cumecs). Peak flows exceed 350 cumecs during the worst storms.

In 2004 an assessment of the river's physical characteristics was carried out to identify a catchment-scale approach for the management of its physical habitat conditions for salmon fisheries.

It concluded that the most significant influences within the Esk catchment were the glacial landscape and topography, and the intensity and extent of grazing (See Map 2).



Map 2. Geomorphological behaviour of the Esk catchment.
From Catchment Fluvial Geomorphological. Audit of the Esk Catchment 2004, Environment Agency/Babtie, Brown and Root.

Water quality throughout is generally good and the river supports abstraction for drinking water from both its headwaters and its lower reaches.

The headwaters suffer from natural acidification from the peat moorland though natural buffering means this is localised. Intermittent pollution from farm slurry has been recorded in the catchment.

The topography of the tideway is narrow and shallow with a pool and riffle nature at low tide. The tidal rise is between four and six metres at Whitby but less at Ruswarp and the width of the river at high tide is up to 40 metres in places. Except near Whitby the river banks are rural and mainly wooded.

Ruswarp weir is still an obstruction to fish passage, despite the presence of a fish pass. Whilst fish wait for favourable conditions to move upstream, they move up and down with the tide where they are highly visible and very vulnerable.

4. Salmon and sea trout fishing

Salmon and sea trout angling in the river Esk is well documented since the middle of the nineteenth century. In 1960 some 350 salmon rod licences were issued for the river. In the non-tidal river fishery, ownership is in the hands of local individuals and clubs and fishing can be closely controlled.

In the tidal reach however, fishery ownership is disputed. Whilst a fishery association does claim ownership to the fishery this was subject to challenge and remains unresolved. The stretch is, therefore, uncontrolled and unregulated by any organised body and there are no means of controlling the levels of fishing other than by byelaw.

At the public inquiry into the first byelaw in 1984 the Inspector accepted, on the basis of returns from tagged salmon, that 72% of the total Esk salmon catch had been taken from this short stretch of the river.

Salmon and sea trout netting in the sea around the mouth of the River Esk has been regulated since the mid nineteenth century. Some forty-six drift net licences operated around this area in 1960. The effect of successive Limitation of Net Licences Orders reduced this to twenty-five in 1987 and seven in 2001. Just two have operated here since 2003.

Ten T/J nets licences in this district were first authorised in 1993. Only two were taken up by 2001 but after 2003 the number has increased and in 2010 all ten were taken up.

Total catches of salmon and sea trout have fallen with these reductions and changes in netting effort.

5. Regulation of fishing

5.1 The Esk byelaw

During the 1960's declared rod catches averaged 475 salmon and 458 sea trout per year reaching a peak of 924 salmon and 640 sea trout in 1965. In subsequent years catches of salmon declined markedly and consistently with a low of only 11 fish being caught in 1989. Annual sea trout catches also declined over a similar period though with more variability in their numbers. There was concern that the salmon runs would be extinguished and sea trout runs severely depressed.

This decline in River Esk rod catches contrasted with Northumbrian rivers (particularly the Coquet, Tyne and Wear) to the north of the Esk, where catches were maintained or increased, over the same period. It was concluded that the decline of salmon in the River Esk was therefore specific to factors associated with that river, and not to a general decline in the population of salmon along the east coast.

The nature of the tideway and the lack of clear ownership made it highly attractive to illegal fishermen, who, with snatches[1], [1]gaffs and gill nets, and often under the cover of legitimate angling, took a heavy toll of the salmon trying to make their way back to their spawning grounds upstream. It was concluded that this high level of exploitation was the key factor in the decline of salmon stocks in the river

Given the position of the tideway as gateway to the river and spawning grounds for salmon and sea trout the conditions outlined above posed a significant threat to returning stocks and restricted the recovery of runs naturally and in response to restocking, habitat improvements and other legislative controls.

A proposal to control fishing on the tideway by byelaw was promoted by the Environment Agency's predecessors in 1979. A Public Inquiry was held in 1984 and the inspector supported the case for a byelaw with recommendations about the byelaw, and other measures, for the protection of stocks in the area. As a result, the byelaw was confirmed in 1987 for an initial period of ten years.

The situation was monitored over the following years when a loophole was discovered which enabled illegal fishermen to continue their activities under the guise of fishing for sea fish, as the byelaw related only to salmon and trout. In 1997 the Esk Tideway Byelaw was amended to close this loophole and renewed for a further five years. The amended byelaw prohibited fishing for all fish between between Ruswarp Weir and Eskside Wharf, but allowed rod fishing for sea fish during the daytime when good visibility enabled better enforcement. This byelaw was renewed in 2002 for ten years.

[1] Snatches are large hooks dragged across a fish to catch it by foul hooking.

5.2 Other legislation

Since the confirmation of the Esk Tideway Byelaw, other national and local legislation changes have been introduced to protect and support salmon conservation, which also benefit stocks in the area.

They include:

- The 1991 North East Coast Limitation of Net Licences Order (NLO), which introduced the principle of reducing the number of drift net licences in the net fishery.

- The Whitby Conservation Area Byelaw in 1994, to enlarge the protection area around the mouth of the river.

- National salmon byelaws in 1999 (including mandatory catch and release of salmon by anglers before June 16th and preventing net fishing before 1st June).

- NE Regional byelaws 2001 (including restrictions on fishing below obstructions and fishing at night).

- The renewal of the Limitation of Net Licences Order 2002

- Renewal of National Salmon Byelaws 2009

- The Ban on the Sale of Rod Caught Salmon 2009

- Tagging and Log Book Byelaws (for licensed nets) 2009

6. Actions to support salmon & sea trout stocks

There are a number of recent, ongoing and planned actions in the Esk catchment that are complementary to the Esk Tideway Byelaw in supporting the conservation of stocks of migratory salmonids.

6.1 Water Framework Directive (WFD)

The aim of the WFD is to improve the status of all waters to 'good'.

Ongoing work for the Esk catchment to deliver the requirements of the Water Framework Directive (WFD) seeks to promote improvement in all parts of the river not achieving good ecological status.

The work links closely with the Esk Catchment Sensitive Farming scheme that focuses on tackling agricultural pollution, including diffuse sediment problems through advice and promotion of land management schemes.

In the Esk catchment there are a number of ongoing investigations into the cause of fish failures and a programme of measures is being implemented which addresses the cause of these and other failures.

Measures taken through WFD will support and complement improvements to salmon and trout stocks alongside the benefits from the effective regulation of fishing.

6.2 Catch and Release

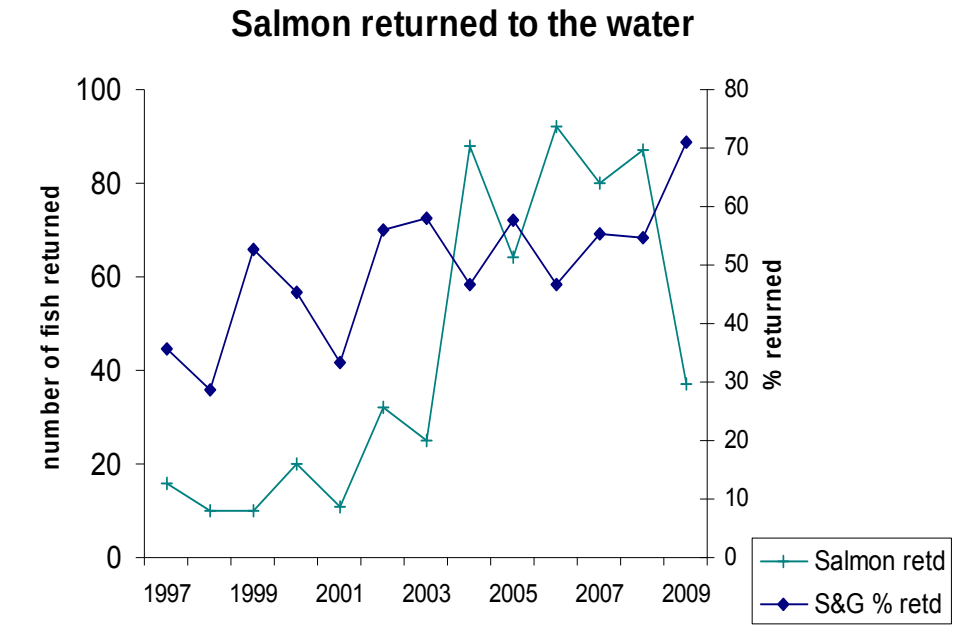
Since the introduction of the first Esk Tideway Byelaw in 1987, voluntary catch and release of salmon throughout the season has been promoted. National byelaws requiring the return to the water of salmon caught by rod before 16th June have been introduced in order to protect and benefit salmon populations.

This encouragement has been extended also to the voluntary return of sea trout. Records of the numbers of fish returned to the water have been collated since 1993 through the national rod licence catch returns system.

The numbers of salmon and sea trout released back to the river by anglers after capture have increased since the 1990s (Figure 1 below).

Although the rate of return of the less frequent, larger salmon has increased markedly, release rates of salmon and grilse combined have remained relatively constant.

The practice of catch and release is actively promoted within the valley and now overall hovers around the 50% level. For sea trout the percentage of fish being returned has increased more steadily and now also exceeds a 50% return rate.



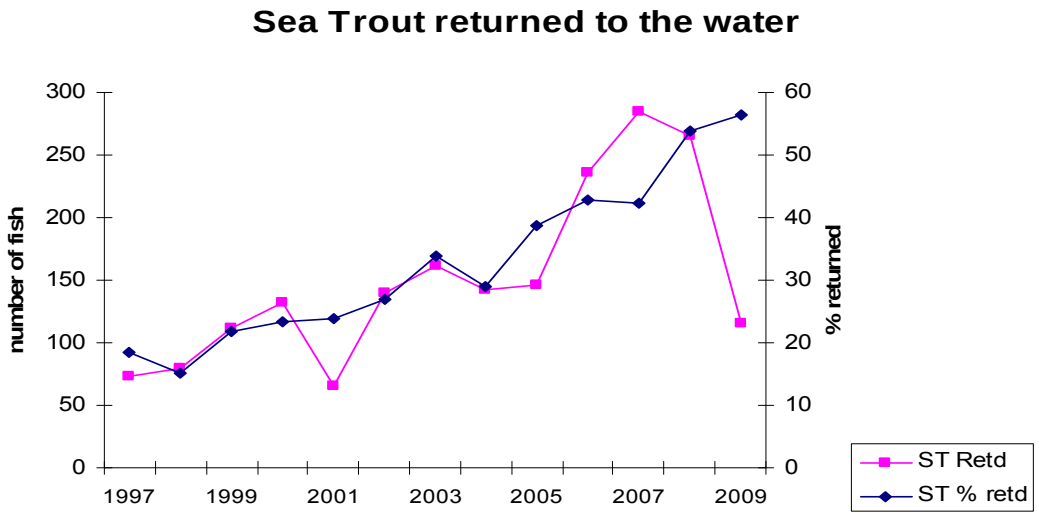


Figure 1. Percentage of salmon and sea trout returned to the water in the Esk catchment.

6.3 Habitat Improvements

Identified habitat issues have been addressed through various improvement works to benefit salmonid stocks and protect the river environment.

Over 27kms of riverbank have been fenced to prevent livestock trampling the banks and river bed and allow riverbanks to regenerate. This will reduce silt entering the river and the subsequent sedimentation of spawning beds. The work is continuing with the long term aim of reducing all man made silt inputs in the river.

Joint work with foresters at the top of the Esk aims to reduce and prevent silt introduction arising from forest management activities, and action has been taken to clear tributaries of the blockages to fish passage which have built up over the years.

6.4 Salmon Stocking

Fishery interests along the Esk have continued to fund stocking programmes using Esk broodstock fish and hatching eggs and rearing fry at the Kielder salmon hatchery. A total of 996,000 0+ and 196,998 1+ salmon have been stocked into the river since 1987 – see table 1.

Year	0+ fry	1+ parr
1987	69,000	14,000
1988	0	10,02
1989	0	12,911
1990	0	9,945
1991	50000	50000
1992	60,000	50,000
1993	10,000	5,202
1994	50,000	6,866
1995	0	7,852
1996	0	3,700
1997	15,000	1400
1998	60,000	0
1999	25,000	0
2000	30,000	0
2001*	0	0
2002	40000	12000
2003	60000	0
2004	60000	0
2005	60000	0
2006	60000	0
2007	60000	0
2008	65000	0
2009	95000	0
2010	90000	0

* - No stocking due to Foot and Mouth restrictions

Table 1 – River Esk Salmon Stocking 1987-2001

7. Stock status

There are several ways in which we assess and monitor our stocks of salmon and trout.

Rod catches of adult salmon and sea trout have been reported for over a hundred years and whilst subject to variability in angling conditions, effort and regulation remain fundamental to monitoring trends and performance in their fisheries.

Net catches are similarly reported, though with more extensive effort data. However neither relate to the whole period of salmon and sea trout migration.

Electric fishing surveys in the river provides an assessment of juvenile stocks, though limited by the number of sites that can be surveyed. Downstream migrating smolt numbers can be assessed through the use of smolt traps, whilst the number of upstream migrating adults can be assessed with fish counters. Again, though, all are subject to variability of fishing conditions.

Analysis of such data over many years and many rivers has enabled us to determine performance standards and classifications for salmon and sea trout – the Fisheries Classification System, the Water Framework Directive Fish Stock classification, the Salmon Conservation Limit and Management Target, and the Sea Trout Classification Scheme.

7.1 Water Framework Directive Status

The European Water Framework Directive (WFD) requires all waters to be assessed against a range of biological and chemical parameters and for these assessments to be combined into a classification of status. The Directive requires river basin management plans to be drawn up setting out actions to ensure all waters achieve Good Ecological Status by 2015. An assessment of the status of fish is included and a significant part of the Environment Agency's fisheries monitoring is targeted to providing such assessments

WFD classifications of fish status are made using electric fishing data and the Environment Agency's Fisheries Classification Scheme Tool 2 (FCS2).

Appendix 1 provides the latest assessment of fish status for the River Esk water bodies.

The main River Esk is split into three water bodies - from its source to Baysdale Beck, from Baysdale Beck to Sleddale Beck, and from Sleddale Beck to Ruswarp. Of these, the latter two are passing ('good' status), whilst the most upstream section is failing ('moderate' status) due to lower than expected densities of brown trout and an absence of salmon.

All but one of the tributaries are failing for fish status due to low numbers of brown trout and salmon, and five of these are currently being investigated.

The main pressure in the Esk catchment is diffuse sediments within the river as a result of agricultural land management, specifically cattle poaching. There are other limiting factors including the barrier that Danby Mill weir presents to fish passage on the main river and intermittent slurry incidents on Glaisdale Beck.

7.2 Assessment Of The Salmon Stock Against Conservation Limits

For the principal salmon rivers in England and Wales, conservation limits (CLs) have been developed that indicate the minimum spawning stock levels below which stocks should not fall. The Environment Agency has further determined Management Targets which mean that the CL is met or exceeded at least 80% of the time. The probability of meeting this target allows classification of the current and predicted future stock of salmon as shown below. Table 2

Table 2

Class	Status
Not at risk	> 95% probability of meeting the management objective
Probably not at risk	between 50% and 95% probability of meeting the management objective
Probably at risk	between 5% and 50% probability of meeting the management objective;
At risk	<5% probability of meeting the management objective

The River Esk is the only principal salmon river in Yorkshire and its CL is calculated at 2.02 million eggs. It does not have a counter or trap for measuring the number of upstream migrating adults and so the procedure for estimating egg deposition utilises annual rod catch returns. This assesses the CL to equate to a rod catch of about 160 fish. The Management Target for the river is 2.64 million eggs equating to a rod catch of about 200 fish.

Salmon egg deposition in the River Esk in relation to its conservation limit over the past ten years is shown in figure 2. The latest assessment for salmon performance in 2010 is that it attained 63% of its conservation limit. It is currently considered to be **'at risk'**, and predicted to be **'probably at risk'** in 2015.

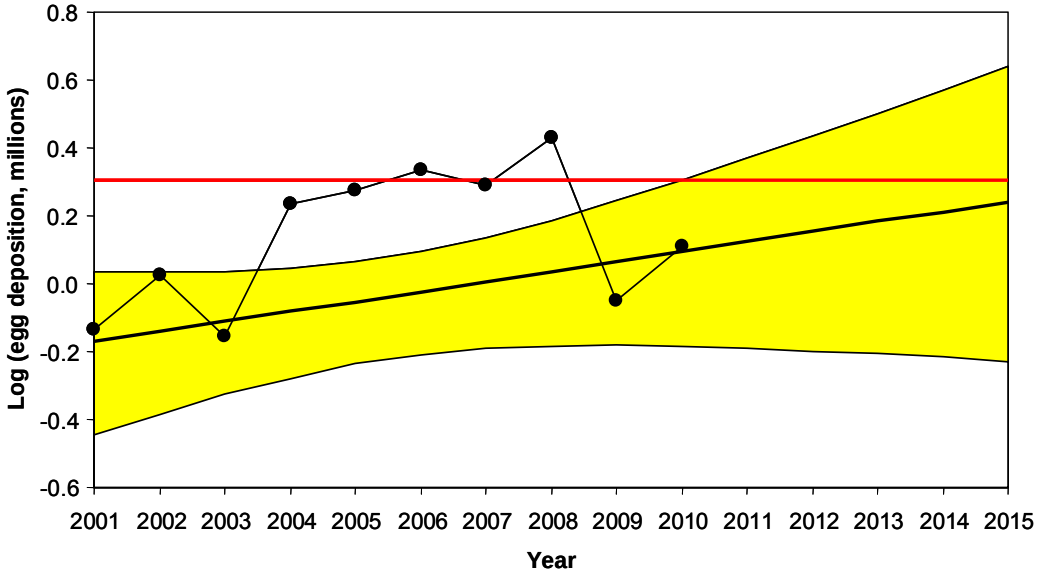


Figure 2. Estimates of egg deposition and compliance with the Conservation Limit for the River Esk. The red line is the Conservation Limit, the black line is the 20th percentile and the yellow shaded area indicates the probability that the river is meeting its Conservation Limit

7.3 Sea Trout Classification

The Environment Agency has recently adopted a method of categorising the status of sea trout stocks based on a comparison of recent catch data with the longer term record for the river. The approach uses two criteria - trend in Catch per Unit Effort (CPUE) in the rod fisheries in the last 10 years and current CPUE relative to the previous 10 years. The results have been categorised using the same terminology as that used for salmon as shown below. Table 3

Table 3

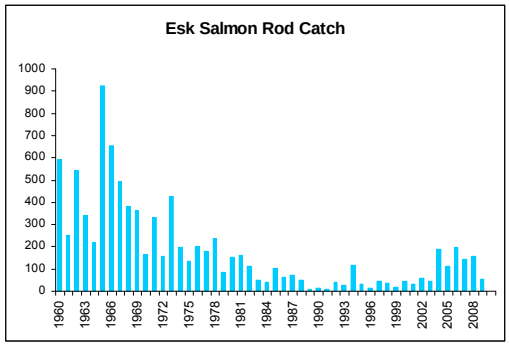
Category	Status
Not at risk	Trend in CPUE significantly up or stable & current stock more than 80% of reference period.
Probably not at risk	Trend in CPUE stable & current stock between 50 and 80% of reference period
Probably at risk	Trend in CPUE stable & current stock is between 20% and 50% of reference period.
At risk	Trend in CPUE significantly down & current stock less than 20% of reference period

The 2010 assessment for the River Esk is that the trend in sea trout CPUE is stable and the current stock is between 50 and 80% of the reference period. It is therefore assessed as **"probably not at risk"**

7.4 Rod catch data

Total rod catch of salmon in the river Esk declined markedly from the late1960s, the period prior to and during the first introduction of the Esk Tideway Byelaw, reaching a low of just 11 fish in 1989. It remained at a low level during the 1990s before showing recovery from 2004. This pattern differs from those of other North East rivers which maintained or improved stocks consistently over this time.

Figures 3a and 3b below shows the data for rod catches from the river Esk and from other North East rivers (the Coquet, Tyne and Wear).



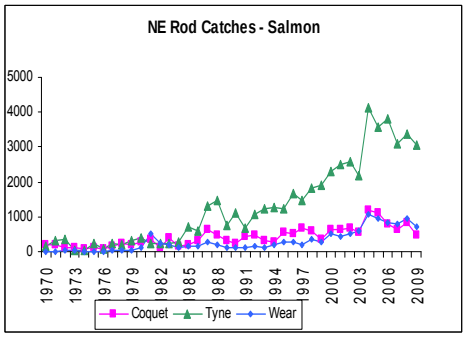
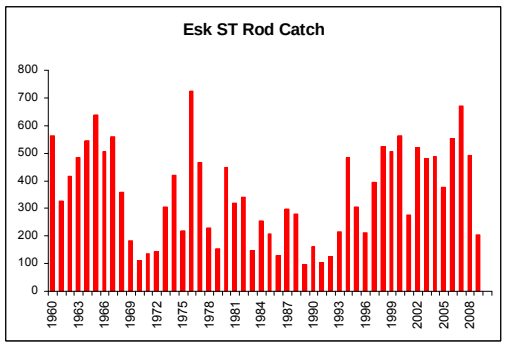


Fig 3a Rod catches of salmon in R Esk **3b Rod catches of salmon other rivers**

Rod catches of sea trout have been more variable but show a decline from the mid 1970s with recovery from around 1990. Figures 4a and 4b.



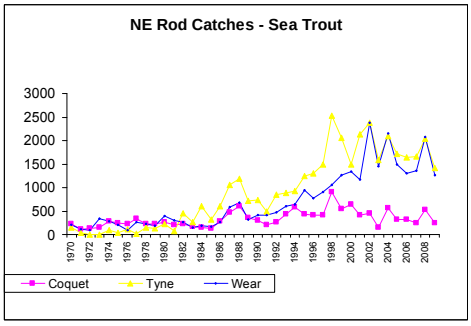


Fig 4a Rod catches of sea trout in R Esk **4b Rod catches of sea trout other rivers**

The increase in the salmon catch after 2003 may be associated with a significant reduction in exploitation by nets on the coast following the buyout of drift net licensees, however, other factors may also have been involved.

The rod catch fell to a low level again in 2009 and this coincided with low rainfall and low river flow throughout the period of that angling season. Figure 5 below,

shows the cumulative daily flow for the R. Esk at Briggswath, near Sleights for the years 2002 to 2009 The pattern suggests that river flow during the angling season is a key factor in the level of rod catches. The years with low rod catches were 2002, 2003, and 2009

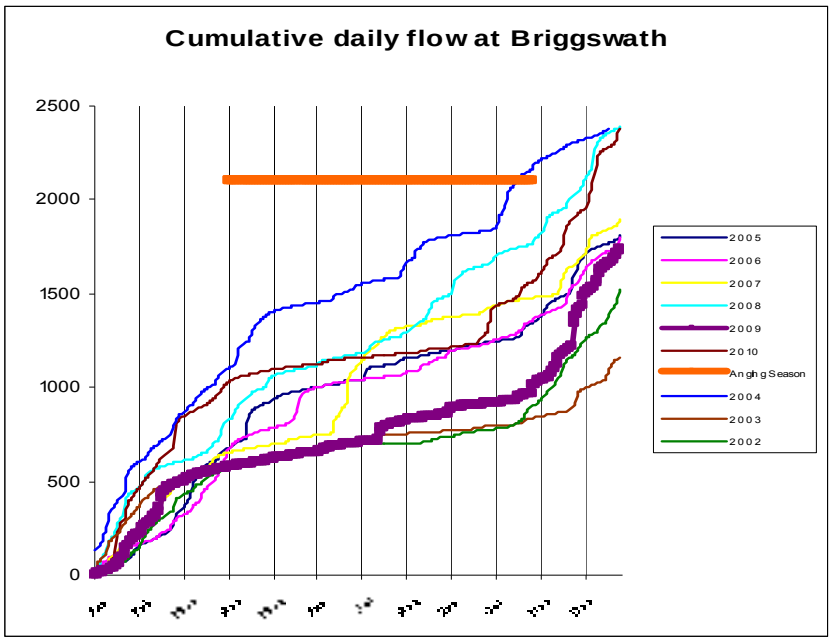


Figure 5 Cumulative daily flow in cumecs at Briggswath (R Esk) 2002 to 2010

7.5 Rod Catch Per Unit Effort (CPUE)

Since 1993 angling effort data has been collected and the patterns in catch per unit effort (CPUE - or catch per licence day CPLD) for all North East principal salmon rivers were examined across three time periods relating to the different generations of the byelaw: 1993 to 1996; 1997 to 2001; and 2002 to 2009 (figures 6 and 7 below). (see Appendix 3 for more details of this analysis)

All of the rivers including the Esk show an increase in CPLD across these periods for both salmon and sea trout. However the patterns of change on the Esk are different.

For salmon in the River Esk there appears to be no increase in CPLD until the latest time period (2002 – 2009) whereas for the other rivers the increase appears gradual over the successive periods.

For sea trout, a significant increase is seen between periods 1993-96 and 1997-2001 which again differs from the other North East rivers where significant increases are only seen between the first and last periods. However, the Esk does show higher levels of CPLD for sea trout than any of the other rivers across the time periods

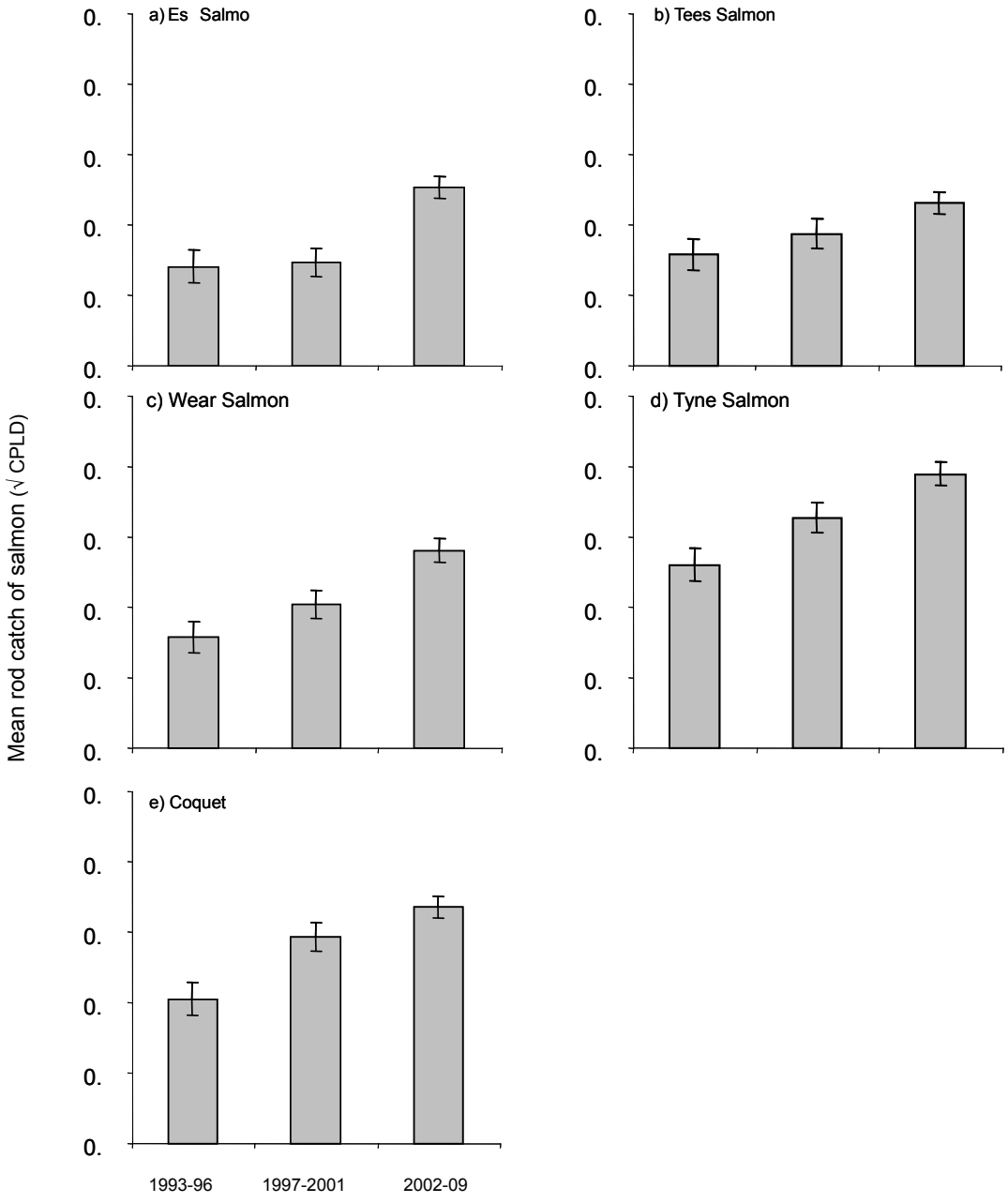


Figure 6 a – e. Mean rod catch (√CPLD) of salmon for North East rivers for three time periods: 1993 to 1996; 1997 to 2001; and 2002 to 2009. Error bars are ± 1 Standard Error.

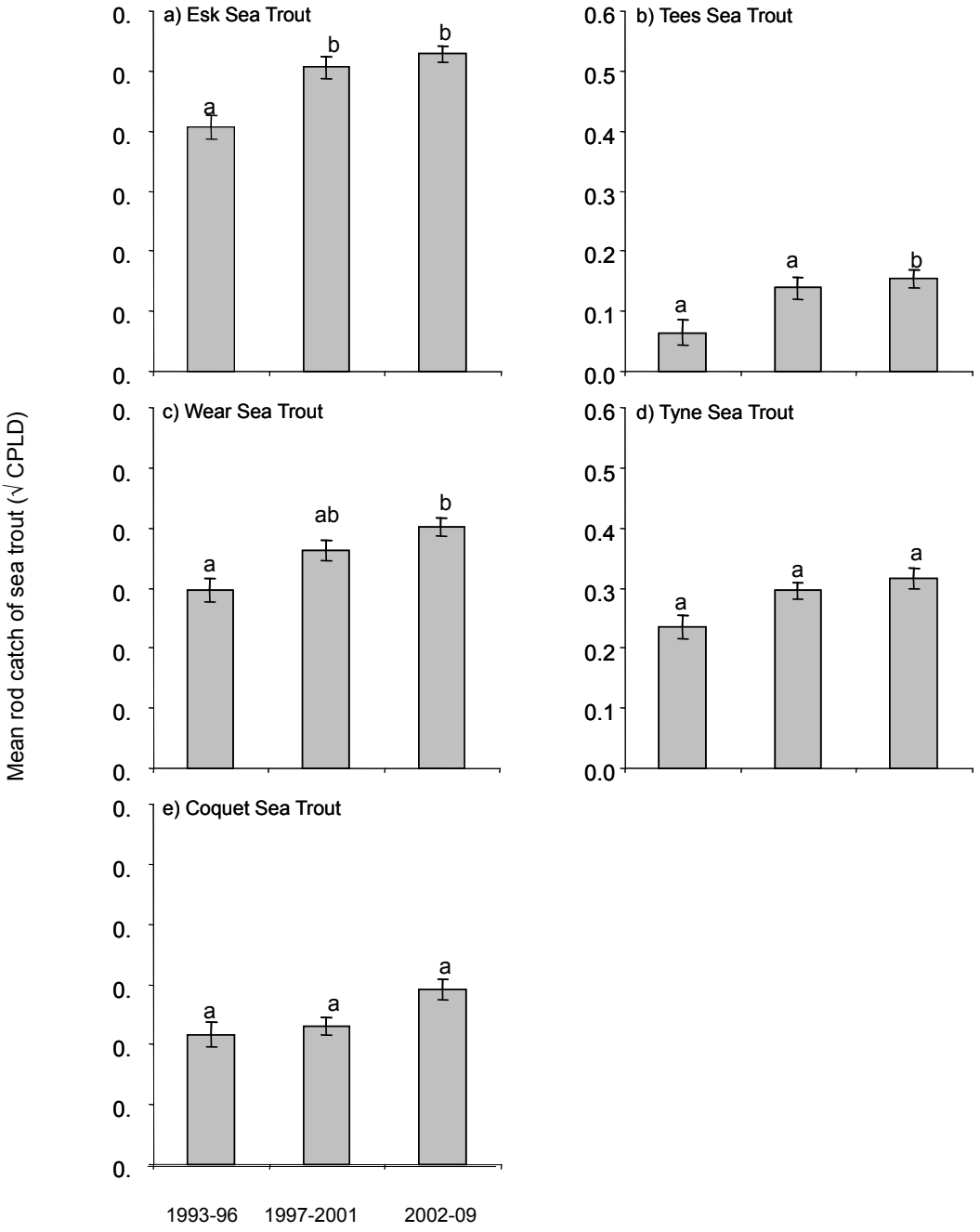


Figure 7 a – e. Mean rod catch (√CPLD) of sea trout for North East rivers for three time periods: 1993 to 1996; 1997 to 2001; and 2002 to 2009. Error bars are ± 1 Standard Error.

7.6 Electric fishing data

Electric fishing surveys of the fish populations in the River Esk and on rivers in the North East of England have been carried out on an annual basis since 1989. Three sites on the River Esk were comparable over that time. (see Appendix 2 for more details of this analysis)

Data from electric fishing monitoring at two sites in the river Esk are illustrated in the figures below. In the third site (Toll Road) salmon density appears to be strongly influenced by river flow. The monitoring was conducted at Lealholm in the mid-sector of the river and at Dibble Bridge in the river's upper reach. Figure 8 shows the data for juvenile salmon and for trout. Median densities of fish are shown for the three time periods, 1989 – 1997, 1998 – 2002 and 2003 – 2010. and presented in table 4.

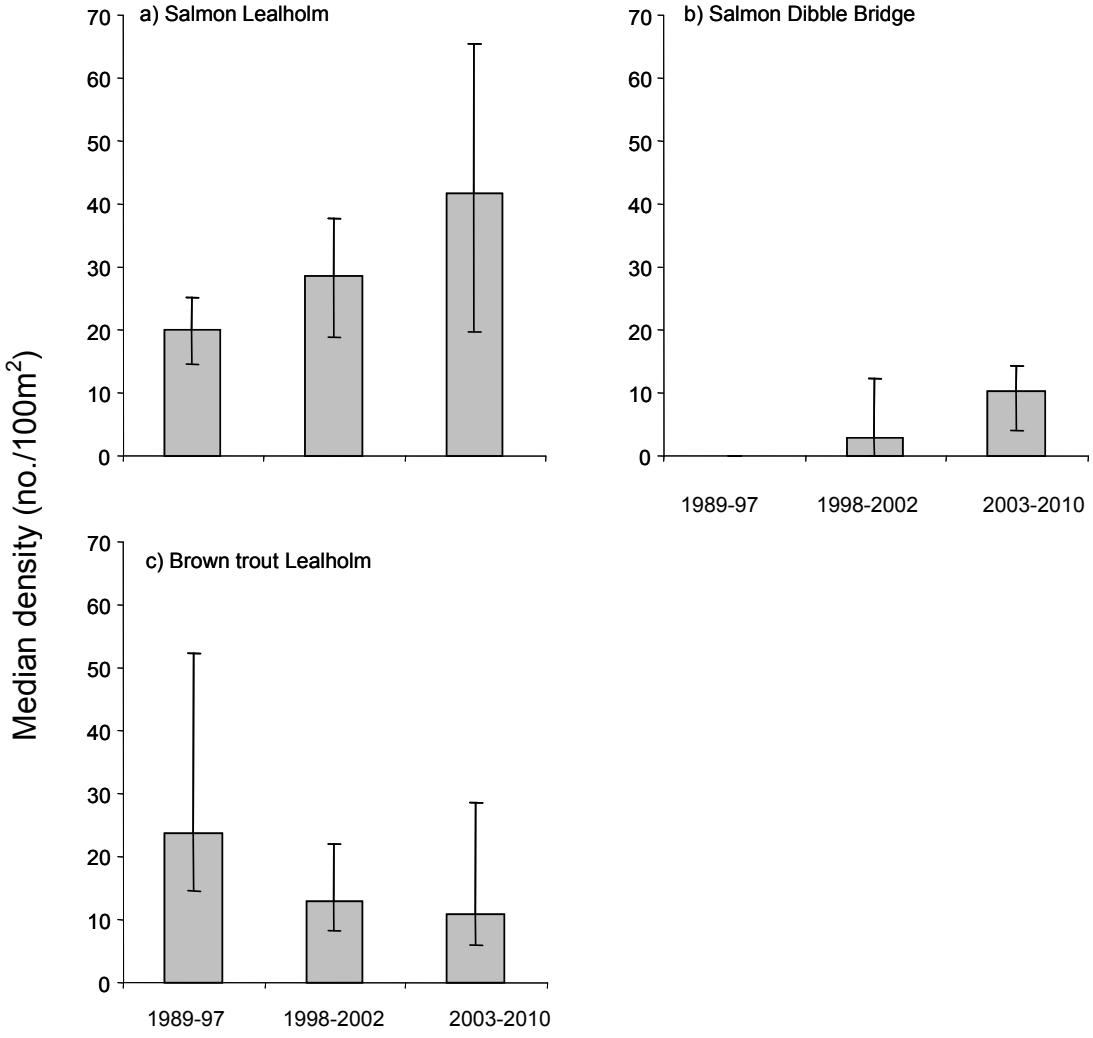


Figure 8. Median juvenile salmon and trout densities at River Esk sites for periods1989 to 1997, 1998 to 2002 and 2003 to 2010. Error bars are 95% Confidence Intervals. .

There has been a general increase in juvenile salmon density on the River Esk that is associated with the different time periods in the implementation of the Esk byelaw, (Figure 8 and Table 4). This increase is statistically significant at two out of the three sites on the River Esk. At the third site,(Toll Road) patterns in salmon density appear to be strongly affected by flow.

Table 4. Median densities of salmon and trout in each byelaw period for each of the rivers examined.

	Median salmon density (no. / 100m^2)			Median trout density (no. / 100m^2)		
River	1989- 97	1998-2002	2003-10	1989- 97	1998-2002	2003-10
Esk	6.8	5.5	14.2	18.8	12.8	11.0
Tees	2.9	5.3	12.0	8.4	3.8	12.0
Tyne	88.5	63.5	34.0	19.0	22.5	5.0
Coquet	40.0	66.5	63.5	128.0	63.5	55.0
Wear	17.0	19.0	22.0	62.0	59.0	76.9

The only significant change in trout density in the River Esk was the reduction at the Lealholm site, though reductions were also found on the Coquet and Tyne.

Figure 9 shows the overall composition (salmon against trout) of juvenile stocks.

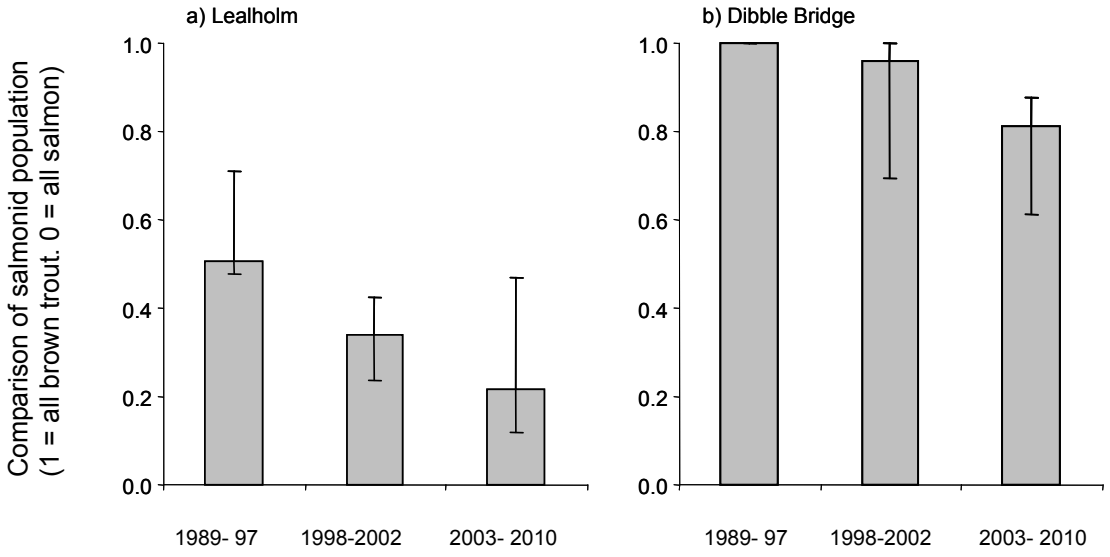


Figure 9. Composition of salmonid populations on the River Esk, in each period. 1989 to 1997, 1998 to 2002 and 2003 to 2010. Error bars are 95% Confidence Intervals.

The proportion of salmon in the salmonid population increased significantly at the two Esk sites. Only one other North East salmon river - the River Tees - mirrored the changes observed in the River Esk, ie increased salmon densities and

increased proportion of salmon in the salmonid population. The River Tees is a river currently in the process of recovering from historical pollution and changes in salmon density and salmonid composition are undoubtedly linked to this.

7.7 Smolt trapping data

Table 5 below shows the estimates of the downstream migration of salmon smolts in the river Esk from operation of a smolt trap at Ruswarp from 1994 until a change in monitoring regimes ended operation after 2008.

Re-capture of marked smolts to ascertain trap efficiency showed the trap to be 10% to 13% efficient.

There have always been good numbers of sea trout smolts caught in the trap, but it is now evident that as adult salmon numbers improved so too did the salmon smolt numbers. There has been a noticeable increase in the salmon to sea trout ratio in recent years from an average of 2.7 salmon to 10 sea trout in the first five years, to 4.7 salmon to 10 sea trout in the last five.

Table 5

		Salmon Smolts		Sea Trout Smolts		
Year	Days run	Catch	Run estimate	Catch	Run estimate	ST:SA Ratio
1994	58	3927	17850	12959	80994	3.30
1995	23	6087	27668	13572	84825	2.23
1996	31	2458	12937	8539	129379	3.47
1997	29	1021	5374	7164	108545	7.02
1998	25	2687	17528	6272	25434	2.33
1999	41	5587	36445	19674	79781	3.52
2000	22	955	6230	1801	7303	1.89
2001	32	3087	20137	12042	48832	3.90
2002	42	3774	24618	12972	52603	3.44
2003	46	4131	26947	10118	41030	2.45
2004	29	4282	27932	9278	37624	2.17
2005	31	5686	37091	10919	44278	1.92
2006	33	8273	41365	19699	79882	2.38
2007	28	4370	21850	7501	30418	1.72
2008	30	4278	21390	9959	40385	2.33

A comparison of the mean salmon run estimate for the first five years of operation (16,271) and that for the last available five years (29,926) supports the view of an improvement in salmon production in the river. However, there is considerable variability in the annual estimates.

7.8 Adult fish counter data

A fish counter was installed in the river at Sleights weir in 1998 in order to enable an assessment of upstream runs of both salmon and sea trout. Unfortunately the site suffered repeated damage from floods and debris and a major flood in 2000 finally washed it out, with the result that the facility has been inoperable since.

A new counter was installed in the fish pass at Sleights in 2010. No results are yet available but it is expected to provide valuable information on the runs of fish in the river in the years to come.

7.9 Stock status summary

The assessments described above show an improvement in the stocks and catches of salmon in the River Esk over the last 15 years and similarly of sea trout over the last 20 years. Rod catches of sea trout have recovered markedly and now are close to, but still less than, historic levels. These changes are different from those seen in the other North East salmon rivers and point to a beneficial impact of the byelaw on River Esk stocks of migratory salmonids.

A reduction in juvenile trout densities over the same period is indicated but similar changes are also found in the rivers Tyne and Coquet, suggesting some other more widespread factor(s) involved in this.

Thus, the overall picture for salmonid stocks is positive, though improvement is still needed in order to achieve the various key performance indicators that have been defined in relation to the river.

- Improvement is needed to achieve “good status” for fish that is a requirement under the Water Framework Directive;

- it is needed to achieve the Conservation Limit and Management Target for salmon egg deposition which are geared to secure sustainable salmon stocks, and

- it is needed to protect and improve catches which underpin the classification of sea trout performance.

Whilst salmon stocks remain “At Risk”, and “Probably at Risk” in five years time, and whilst sea trout stocks fall short of being assessed as “Not at Risk” there will be a need to look to further improvements in the catchment and the maintenance of stock protection.

8. Management Options

In the light of the assessments above, it is appropriate to consider the range of options for control of fishing in the Esk tideway from 2012.

Option 1 - Do Nothing - Allow The Tideway Byelaw To Expire

The current byelaw will expire in February 2012, unless it is remade, and the legal protection it affords to migrating salmon and sea trout will be lost. This byelaw has played a major role in delivering powers to protect and ensure the safe passage of salmon and sea trout through the tideway where, without effective regulation and control they are extremely vulnerable and the continued recovery of stocks and associated benefits would be threatened.

In this situation no legal control would be exercisable over the intensity of fishing for migratory salmonids in the tideway. The ability to enforce other salmon and freshwater fisheries legislation would be compromised by the occasional presence of sea fish and the need to prove these were not the target species. Our experience of enforcement before the making of the byelaw and currently elsewhere is that enforcement would be far less effective and demand more resources at far greater cost than can currently be deployed. The legal protection for the fish running through this vulnerable reach would be seriously eroded.

Whilst the stocks of salmon and sea trout are greatly improved on their pre-1990 levels, the river has not yet achieved compliance with its spawning targets (CL and Management Target) and may not do so for another few years even with the byelaw in place. The topography and ownership of the tideway remain unchanged and enforcement required to regulate this open fishing environment is very resource intensive.

- *This option is considered unsustainable and high risk.*

Option 2 - Allow The Byelaw To Expire And Promote Voluntary Controls

Similar considerations as described above apply. With the lack of ownership of and responsibility for the tideway, voluntary controls without the backup of enforceable sanctions are not considered to be a workable option.

- *This option is considered unreliable and high risk.*

Option 3 - Renew The Byelaw

This would maintain the current protection for migratory salmonids through the prohibition of fishing on the tideway for salmon and sea trout at all times and for all fish at night whilst allowing angling for sea fish in the day time The byelaw has benefited local stocks and supported their restoration. It provides an environment for

effective and efficient enforcement activities. It has little impact on angling for sea fish in the tideway, as this is authorised to take place during the daytime.

- *This option is widely supported within the fishing community of the River Esk and is the preferred option.*

Option 4 –Increase Or Extend Controls Provided By The Byelaw

Whilst stocks of salmon and especially sea trout have recovered they are not yet in the position where they can be assessed as "not at risk". However there is no evidence yet to suggest that additional restrictions on fishing in the tideway are warranted or practicable and there are no other similarly vulnerable or uncontrolled stretches in the river to which this type of control could be applied.

The imposition of other controls on fishing elsewhere in the river is not judged to be necessary for sea trout. Salmon, whilst still a matter for concern, appear to be recovering under the present legislative controls.

Apart from any impact on fish stocks, the effect of an extended prohibition of fishing on the local fishing economy, tourism and the communities in the Esk valley could be significant.

- *This option is considered excessive and unnecessary at this time.*

Recommended management option

In view of the above the Yorkshire and North East Region of the Environment Agency propose to remake the River Esk Tideway Byelaw in its current form.

This byelaw prohibits fishing for all fish between Ruswarp Weir and Eskside Wharf, but allows rod fishing for sea fish during the daytime.

(The full text of the proposed byelaw is set out in Appendix 7)

9. Consultation

The Yorkshire and North East Regional Fisheries and Recreation Advisory Committee considered the issue of the River Esk Tideway Byelaw in February 2010 and supported its renewal. (Appendix 6)

Consultation on the proposed byelaw followed with Whitby Town Council, North York Moors National Park, Natural England, Government Office for Yorkshire and The Humber, the North Eastern Sea Fisheries Committee, the River Esk Action Committee and local interested parties.

To date eleven letters of support for the byelaw have been received from local interests including Whitby town council, North York Moors National Park and the River Esk Action Committee. One individual has currently indicated opposition to it.

10. Impact assessment of preferred option

10.1 Biodiversity

The concern first expressed in the 1970s for salmon stocks served to raise the profile of environmental factors in the river and to support concerted actions to address issues where they are identified. Populations of other species of biodiversity importance, freshwater pearl mussel, crayfish, otter and eel, were all identified as matters for concern and opportunities also sought to protect and enhance them wherever possible. The interest in salmon stock improvement has brought together and maintains the driving force behind the efforts to improve the geomorphology in the river.

The recovery of the salmon and sea trout run has positive benefits for the work now being undertaken to protect and improve these stocks and eels benefit from the habitat and access improvements which are made and from the legislative moves (the tideway byelaw, eel regulations, etc.) to support efficient enforcement .

10.2 Recreation and the local economy

Day ticket fishing for migratory salmonids is available within the river and there are a number of “free” fishing locations which also provide opportunity to enjoy improved runs of fish. The work of Radford et al (1991) examined the value of salmon and salmon fisheries in the country and has been taken to guide an assessment of the value to local economies from recovering salmon stocks e.g. through increased angler visits, use of local hospitality, services etc. This has been reinforced by a 2009 Environment Agency survey of peoples’ preparedness to pay for protection and improvement of fisheries

It is reported by local fishery owners that the numbers of day tickets sold for fishing for salmon and sea trout on the Esk has increased and membership of the fishery association has expanded. The Egton Estate, Esk Fishery Association and Danby Angling Club all report more fishing now than ten years ago and a growing demand for fishing availability all of which provide benefit for the local economy.

10.3 Impact on legitimate angling

The byelaw has had no negative impact on legitimate sea fishing. Very little has ever taken place in the tidal reach apart from the odd holiday maker staying at the caravan park and fishing for flounder. Typically these are children accompanied by parents. Other than this, juveniles tend to prefer the harbour area for flounder/billet fishing where the fish are more likely to be present, and parents believe their children to be safer in an urban area. Local commercial interests in the area are amongst those who have previously indicated their support for the byelaw.

Fisheries Officers responsible for the River Esk have seen only a handful of different individuals fishing in this stretch since 1987 and only one has had to be informed as to the closing time for sea fishing in the affected reach since 1997.

10.4 Enforcement

Since the byelaw was introduced, snatching (one of the main methods of illegal fishing previously deployed) has been practically eradicated and the number of illegal nets reported has fallen dramatically. Nevertheless, this reach remains extremely vulnerable to all forms of illegal fishing.

Before the existence of the byelaw, illegal fishing in the tideway was frequent and significant despite the best efforts of a dedicated, experienced and well resourced enforcement team working all hours throughout the main run of fish. (pers comm. 2011).

Being considered a public fishery, access along the tideway at low tide was unobstructed, many poachers were active and any challenge could be passed off simply as legitimate fishing. In response to increased enforcement efforts they employed lookouts and warning signals, so that they could quickly escape or resume apparently legitimate activities on the approach of our officers. Successful enforcement action (prosecution) depended on offenders being apprehended in the act of illegal fishing. Many of the illegal nets were set by the snatchers and they were able to operate freely under these conditions.

When the byelaw was introduced in 1987, it banned fishing for salmon and migratory trout and initially had some beneficial impact in reducing fishing activities but it quickly became apparent that claiming to be fishing for other fish, e.g. sea fish, provided the necessary excuse for continuing activities. In 1997 the byelaw was tightened to cover all fish, except for sea fish by angling in the daytime, and so no excuse for fishing on the tideway, particularly at night, was available. The activities of snatchers and netters then reduced to a very low level.

It was originally estimated that the introduction of the byelaw would allow for a reduction in staff resources devoted to enforcement activity through improvements in effectiveness and efficiency. Since the introduction of the byelaw, it is now estimated that savings of over 80% of pre-byelaw enforcement levels have been secured, equivalent to around £400,000 at current levels. These savings have been made available to support environmental and habitat improvements in the catchment and elsewhere for the benefit of salmon and freshwater fisheries.

Although enforcement activity has been reduced, a consistent pattern of reducing illegal activity has also been seen. Between 1982 and 1986 an average of 28 illegal nets per year were removed from the tideway. This number fell to just 10 between 1992 and 1996. Since 2000 only 8 nets in total have been found and only two offenders have been reported. This is associated with the existence of the byelaw and the effectiveness of the powers it provides to take action against those suspected of illegal fishing

10.5 Local reaction to the byelaw

Whilst there was some opposition to the introduction of the byelaw in 1987 as noted in the report of the Inquiry's Inspector, there has been no demand for its removal since, and only two objections were sustained at the last renewal in 2002 when six letters in support of it were received.

In considering the renewal of the byelaw in 2012, all the angling interests consulted have supported the byelaw and have urged its renewal. Eleven letters of support have been received from local interests including Whitby town council, North York Moors National Park and the River Esk Action Committee. One individual has currently indicated opposition to it.

10.6 Conclusion to the impact assessment

This byelaw has played a major role in delivering powers to protect and ensure the safe passage of salmon and sea trout through the tideway where, without effective regulation and control they are extremely vulnerable and the survival of their stocks and associated benefits would be threatened.

The regulation has provided a cost effective and efficient enforcement regime to allow the limited amount of angling for sea fish that the reach attracts whilst giving proper protection for the vulnerable salmon and sea trout.

There is support for the continuance of the regulation amongst all local angling groups consulted.

11. References

Radford A.F., Hatcher, A.C., & Whitmarsh, D.J. (1991) An economic evaluation of salmon fisheries in Great Britain; summary of a report prepared for the Ministry of Agriculture, Fisheries and Food. Portsmouth Polytechnic. 32 pp.

Environment Agency 2009….

Appendix 1

WFD fish status of all waterbodies in the Esk catchment and summary of pressures and ongoing actions.

Waterbody	Current fish status	Main Pressures	Investigations/actions
Main river			
River Esk from Source to Baysdale Beck	Moderate	Diffuse sediments	WFD investigation ongoing into fish status and cause of failure.
River Esk from Baysdale Beck to Sleddale Beck	Good	Diffuse sediments, fish passage issues at Danby Mill	
River Esk from Sleddale Beck to Ruswarp	Good	Sediment, diffuse phosphate	River Esk Pearl mussel and Salmon recovery project ongoing.
Tributaries			
Baysdale Beck from Source to River Esk	Moderate	Diffuse sediments	WFD investigation ongoing into fish status and cause of failure.
Sleddale Beck from Source to River Esk	Moderate	Diffuse sediments	WFD investigation ongoing into fish status, possibility that it is not failing. If it is failing, the cause will be investigated.
Danby Beck catchement (trib of Esk)	Moderate	Diffuse sediments	WFD investigation ongoing into fish status, possibility that it is not failing. If it is failing, the cause will be investigated.
Great Fryup Beck Catchment (trib of Esk)	Moderate	Diffuse sediments	WFD investigation ongoing into fish status, but likely to still be failing. Also WFD investigation to investigate the cause of failure.
Stonegate Beck catchment (trib of Esk)	Moderate	Diffuse sediments	River Esk Pearl mussel and Salmon recovery project ongoing. WFD investigation ongoing to investigate cause of failure.
Glaisdale Beck catchment (trib of Esk)	Moderate	Sediment, diffuse phosphate	Historic slurry incidents and sediment issues. Will be targeted by CSFO.
Murk Esk from Source to Wheeldale Gill	No fish data	Diffuse sediments	Failing for pH – naturally acidic moorland river.
Wheeldale Gill from Source to Murk Esk	No fish data	Diffuse sediments	Failing for pH – naturally acidic moorland river.
Murk Esk from Wheeldale Gill to Eller Beck	No fish data	Diffuse sediments	
Eller beck from Source to Murk Esk	Moderate	Diffuse sediments, phosphate	WFD investigation to investigate the cause of failure ongoing.
Murk Esk from Eller Beck to River Esk	Good	Diffuse sediments	
Little Beck/May Beck catchment (trib of Esk)	Moderate	Diffuse sediments	
Rigg Mill Bk/Long Mill Bk catch (trib of Esk)	Poor	Diffuse sediments	WFD investigation ongoing into accuracy of fish status and cause of failure. Naturally limiting factor for fish is impassable waterfall.
Whitby (North of Esk)	No fish data	None recorded	

Appendix 2
Electric fishing data

Methods

Electric fishing suveys

Electric fishing surveys of the fish populations in the River Esk and on rivers in the North East of England have been carried out on an annual basis since 1989 at a number of sites. Electric fishing is a common fisheries survey method, which enables a stretch of river to be surveyed using a localised electrical current to temporarily 'stun' fish allowing them to be netted easily. They are then placed in a recovery bin or keep net until the end of the survey when they are identified and measured before being returned to the river. Scale samples are taken from fish to allow age and growth analysis to be carried out.

Sea trout are the same species as brown trout (*Salmo trutta*) and there is no way to determine if a juvenile brown trout is likely to migrate to sea and become a sea trout. Therefore brown trout are used in the juvenile salmonid monitoring to determine if changes to the sea trout population have occurred. Unfortunately changes to the number of sea trout may be masked if the majority of a given population are resident brown trout.

Analysis

The data used were from three sites on each of the Rivers Esk, Tees, Tyne, Wear and Coquet. Data from the three sites on the River Esk were examined individually and combined. Only combined data were examined for the other North East rivers. Details for the River Esk sites are shown in Table 1. The site numbers shown in Table 1 are used consistent throughout the report. The names and locations of the sites used for analysis of the other North East river are shown in Table 2.

Table 1. Electric fishing survey sites on the River Esk.

Site Number	Site Name	NGR
ES1	Lealholm	NZ7650607514
ES2	Dibbles Bridge	NZ6757607887
ES3	Toll Road	NZ8223705507

The majority of surveys on all the rivers were completed over a single run although for a short period they were completed over three runs (catch depletion method). Catch depletion allows a more accurate estimation of the fish population present. Unfortunately as much of the historical data was based on single run surveys, only the first run from catch depletion data was used to standardise the data.

Table 2. Names and locations of sites used from other North East rivers.

Catchment	Site name	NGR
Coquet	River Alwin	NT925083
Coquet	River Coquet at Pauperhaugh	NU102995
Coquet	Wreigh Burn	NU030021
Tees	Bowlees Beck	NY907282
Tees	Egglestone Abbey	NZ063153
Tees	Egglestone Burn	NY987236
Tyne	N Tyne at Newton	NY803842
Tyne	River Rede Greenchesters	NY868938
Tyne	South Tyne at Kirkhaugh	NY699494
Wear	River Wear at Stanhope	NY992392
Wear	River Wear at Wearhead	NY857395
Wear	Stanhope Burn at Stanhope	NY990395

Scale samples are taken from fish to allow age and growth analysis. However, during some surveys the number of scales taken has not allowed accurate age and growth analysis. Therefore all data from all rivers has been standardised to total number of juvenile fish. Although this reduces the ability to determine specific years where recruitment is strongest it does allow trend analysis, which is sufficient for the purpose of this report.

Data from 2005 and 2006 for the River Esk at sites ES2 and ES3 have been removed for salmon, and for brown trout at site ES3. These data have been removed due to questionable catches on the first run when compared to the catch depletion data that year. All data collected from the River Esk in 2008 has been removed due to issues identified with the equipment impacting on survey results.

Flow data for the River Esk was obtained from the Hydology team. Data were from a river flow gauge at Briggswath, for the period 1989 to 2010, and was provided as mean monthly flow (cumecs).

Spearman rank correlations were used to determine if changes in fish populations at sites on the River Esk were correlated with river flow. Several different periods of flow data were correlated with salmon and brown trout densities at each site on the River Esk. Each flow period has a recognised affect on fish populations (See Table 3).

Spearman Rank correlation was also used to determine if the density of salmon and brown trout were influencing each other on an annual basis.

The majority of fish data were not normally distributed and could not be transformed to match a normal distribution. Therefore the non-parametric Kruskall-Wallis test was used, which allows for non-normal distributions in data. This test provides an overall test of any significant differences but does not identify which individual groups are different from one another. A visual interpretation was used to examine differences between individual groups.

Table 3.
Flow periods used for correlation test with salmon and brown trout densities.

Flow Period	Reason used/potential influence on fish population
Previous August to October	Impact on migration of spawning adults
Previous September to November	
Previous November to December	
January to March	Impact on eggs in gravels
March to April	Impact on emergent fry
April to June	Impact on early fry stages
July to August	Impact of low summer flows
Date of electric fishing survey	Influence of flow on efficiency of the survey

Changes in salmon and brown trout densities were examined against three time periods (Table 4) which relate to key changes in the existence of the Esk byelaw. Time periods were offset by one year to allow for the byelaw changes to influence the adult fish populations, leading to changes in recruitment and hence changes in juvenile catches. Unfortunately there is no electric fishing data available on the River Esk prior to the introduction of the original Esk byelaw in 1987.

Table 4. Time periods used in statistical analyses

Period	Years	Reason
Byelaw period 1	1989 – 1997	period of bylaw before angling provisions tightened
Byelaw period 2	1998 – 2002	byelaw effective with amendments / pre-NLO and drift net buyout
Byelaw period 3	2003 – 2010	Post byelaw renewal and NLO/drift net buyout

Changes in the proportion of brown trout to salmon were also examined. The proportion was calculated as:

Proportion = total brown trout density / total salmonid density

Therefore 0 = all salmon and 1 = all brown trout. This proportion was used to determine if there was a significant change in the composition of the fish populations relating to the key time periods of the Esk byelaw (Table 3).

The Null Hypotheses (H_o) tested were:

- The mean density of salmon/trout is not related to flow at each site on the River Esk
- The mean density of salmon/trout in each time period is the same, for each site on the River Esk, and for the River Esk overall
- The mean density of salmon/trout in each time period is the same for each North East river
- The mean ratio of salmon: trout in each time period is the same, for each site on the River Esk, and for the River Esk overall
- The mean ratio of salmon: trout in each time period is the same for each North East river

Results

River Esk

Flow

There was no significant correlation between any period of flow (mean monthly flow in cumecs) and salmon or brown trout densities at sites ES1 and ES2 on the River Esk ($p > 0.05$). However site ES3 did show significant correlations between flow and salmon density (for three flow periods) and brown trout density (one flow period significant and one borderline; See Table 5).

Table 5. Significant Spearman Rank correlations between mean monthly flow (cumecs) and fish density for different flow periods at site ES3.

Species	Period	Test statistic (r)	p value
Salmon	Date of survey	-0.71	*
Salmon	March to April	-0.67	*
Salmon	April to June	0.59	*
Brown trout	March to April	0.57	0.053
Brown trout	April to June	0.76	**

Significance levels are: * $p < 0.05$; ** $p < 0.01$.

Fish density

The median density of salmon is significantly different between individual sites on the River Esk ($H = 39.1$, $df = 2$, $p < 0.001$; Figure 1a). This is also true for brown trout ($H = 40.1$, $df = 2$, $p < 0.001$; Figure 1b). However, the pattern is different for each species. Site ES1 has the highest median density of salmon with site ES2 having the highest median density of brown trout.

There is a significant difference in median salmon density across Esk byelaw periods at sites ES1 ($H = 7.83$, $df = 2$, $p < 0.05$) and ES2 ($H = 10.06$, $df = 2$, $p < 0.01$). Figures 2a and 2b show an increase in salmon density across the successive time periods and that the largest differences are between Esk byelaw periods one and three. There was no such difference found at site ES3 for salmon.

Only one site on the River Esk showed a significant difference in median brown trout density – ES1 ($H = 6.41$, $df = 2$, $p < 0.05$). The change is a decrease in median brown trout density over the successive Esk byelaw time periods with the largest difference between periods one and three (Figure 2c).

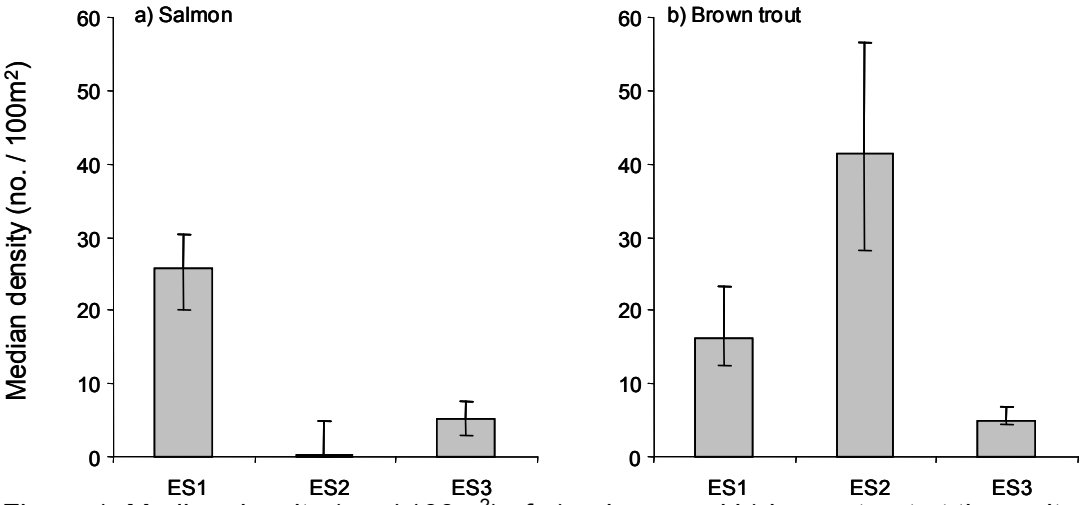


Figure 1. Median density (no. / 100m^2) of a) salmon and b) brown trout at three sites (ES1, ES2 and ES3) in the River Esk. Error bars are 95% Confidence Intervals.

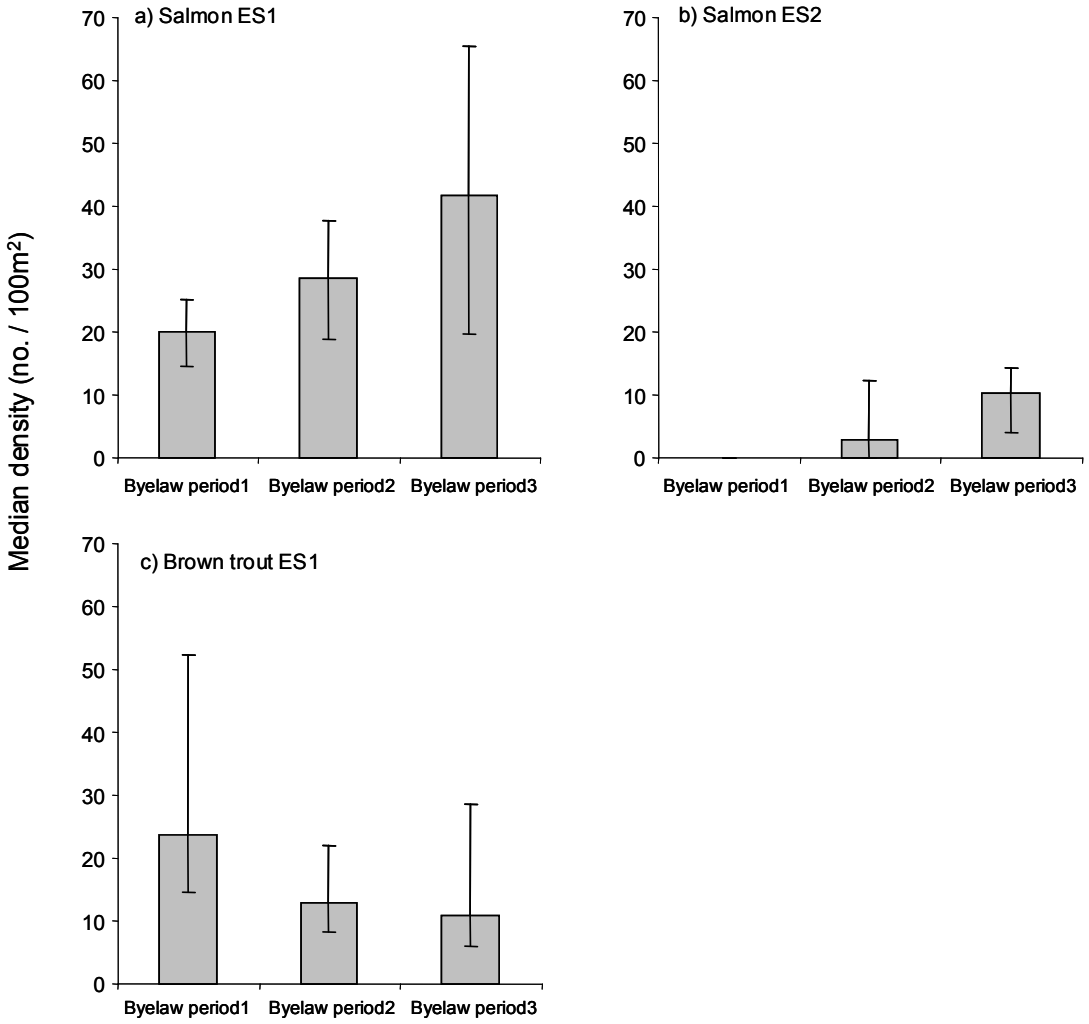


Figure 2. Median salmon densities (no. / 100m^2) at River Esk sites a) ES1 and b) ES2 and c) median brown trout density at site ES1, for each Esk byelaw period. Byelaw period 1 = 1989 to 1997, Byelaw period 2 = 1998 to 2002 and Byelaw period 3 = 2003 to 2010. Error bars are 95% Confidence Intervals. .

Fish population composition

There was a significant difference in the salmonid composition at site ES1 between byelaw periods ($H = 11.27$, $df = 2$, $p < 0.01$). Byelaw period three showed a clear decrease in the proportion of brown trout (and therefore an increase in proportion of salmon) compared with byelaw period one (See Figure 3a). However, there was no significant correlation between salmon and brown trout densities at site ES1 ($r = -0.2$, $p > 0.05$), showing that the species are not influencing each other through competition (e.g. for habitat and food).

The same pattern in composition is also shown at site ES2, although to a lesser extent ($H = 11.27$, $df = 2$, $p < 0.01$; Figure 3b). Site ES3 appears to show an increase in the proportion of brown trout to salmon between byelaw periods one and three. However this is not significant ($H = 5.16$, $df = 2$, $p = 0.076$; Figure 3c).

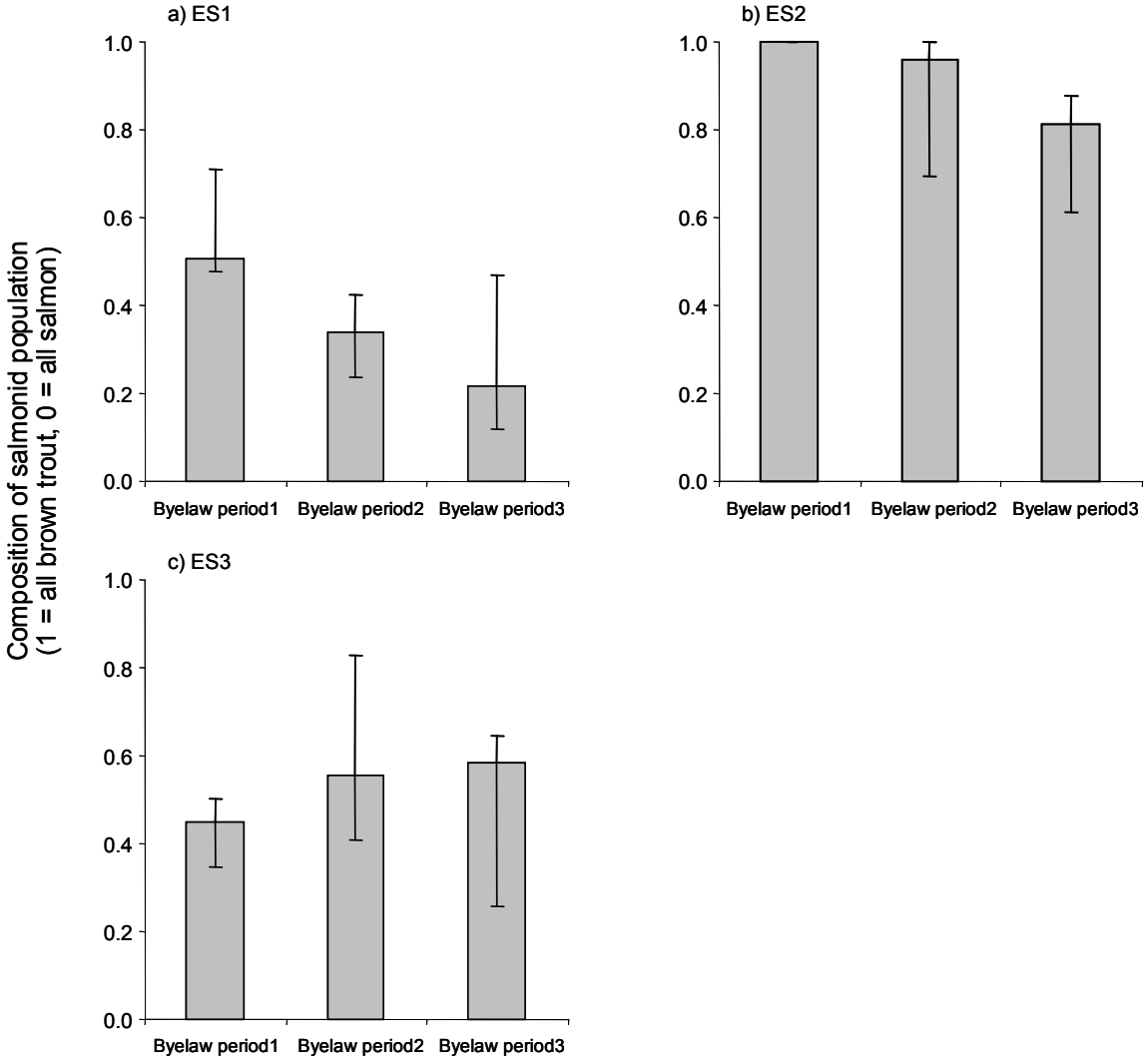


Figure 3. Composition of salmonid populations at sites a) ES1, b) ES2 and c) ES3, in each byelaw period. Byelaw period 1 = 1989 to 1997, Byelaw period 2 = 1998 to 2002 and Byelaw period 3 = 2003 to 2010. Error bars are 95% Confidence Intervals.

Combined site data for River Esk

Data from all sites were combined to examine whether there were any overall differences in salmon or brown trout densities, or in salmonid composition, between byelaw periods on the River Esk as a whole.

For salmon there appears to be an increase in median density in byelaw period one compared with period three, although this is not quite significant ((H = 4.94, df = 2, p = 0.084; Figure 4). There were no significant differences overall for brown trout density or for salmonid composition.

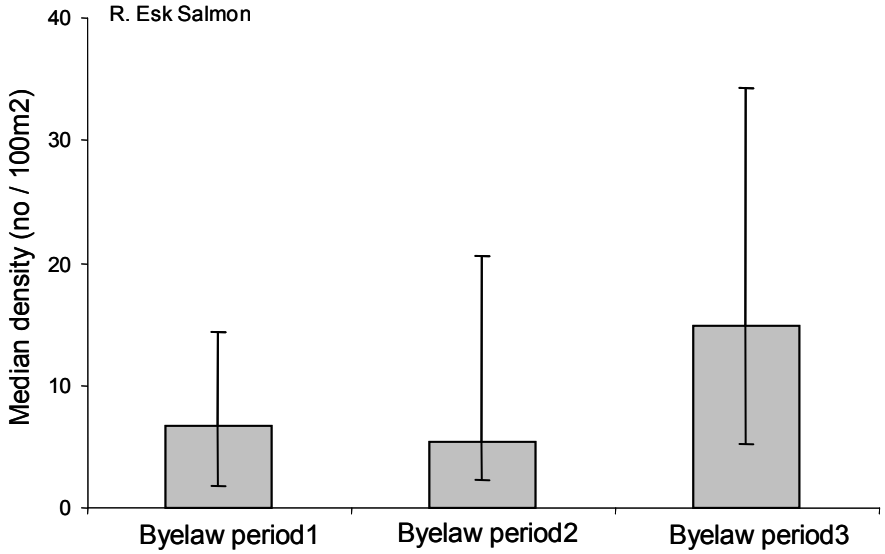


Figure 4. Median salmon densities (no. / 100m^2) in the River Esk (all sites combined) for each byelaw period. Byelaw period 1 = 1989 to 1997, Byelaw period 2 = 1998 to 2002 and Byelaw period 3 = 2003 to 2010. Error bars are 95% Confidence Intervals.

Comparison with other North East rivers

In order to try to separate effects of the Esk byelaw from other influences on North East salmonid rivers as a whole, data from other North East rivers were examined. The results show that some significant changes in fish populations have occurred in these other rivers over the same time periods as have been used for the River Esk analyses above (i.e. time periods significant to key periods of the Esk byelaw).

The River Tees shows a very similar pattern to the River Esk in terms of density of salmon (H = 21.99, df = 2, p < 0.001). Figure 5 shows a clear difference in median salmon density between byelaw periods one and three, and between periods two and three. There were no significant differences in median salmon density in any of the other North East rivers examined (i.e. Rivers Tyne, Wear and Coquet) across the three byelaw periods.

Other North East rivers showed different patterns. The only significant difference though was on the River Tyne for brown trout ($H = 9.91$, $df = 2$, $p < 0.01$). The change is evident as a decrease in median density in byelaw period three compared with periods one and two (Figure 6a). There was a suggestion of decreased median brown trout density in the River Coquet in byelaw periods two and three compared with period one, although this was not quite significant ($H = 5.34$, $df = 2$, $p = 0.069$; Figure 6b).

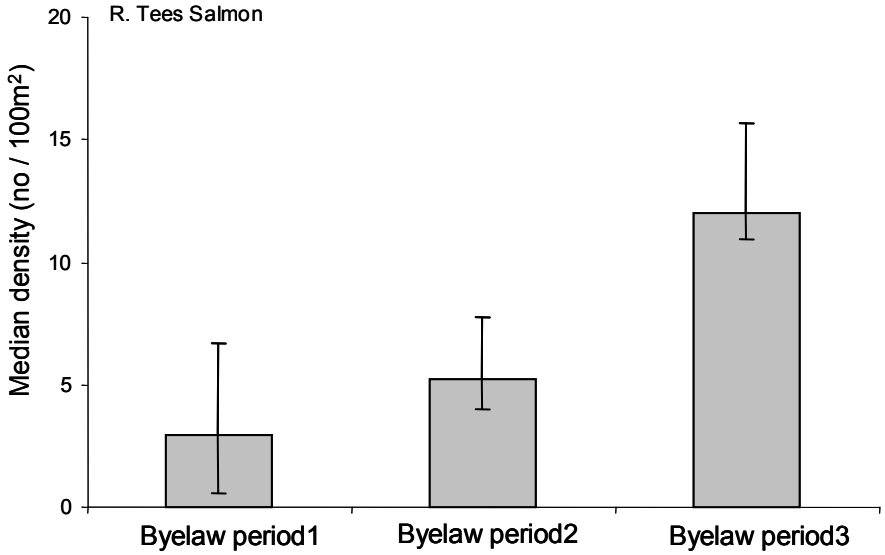


Figure 5. Median salmon densities (no. / 100m^2) in the River Tees (data combined from three sites) for each Esk byelaw period. Byelaw period 1 = 1989 to 1997, Byelaw period 2 = 1998 to 2002 and Byelaw period 3 = 2003 to 2010. Error bars are 95% Confidence Intervals. .

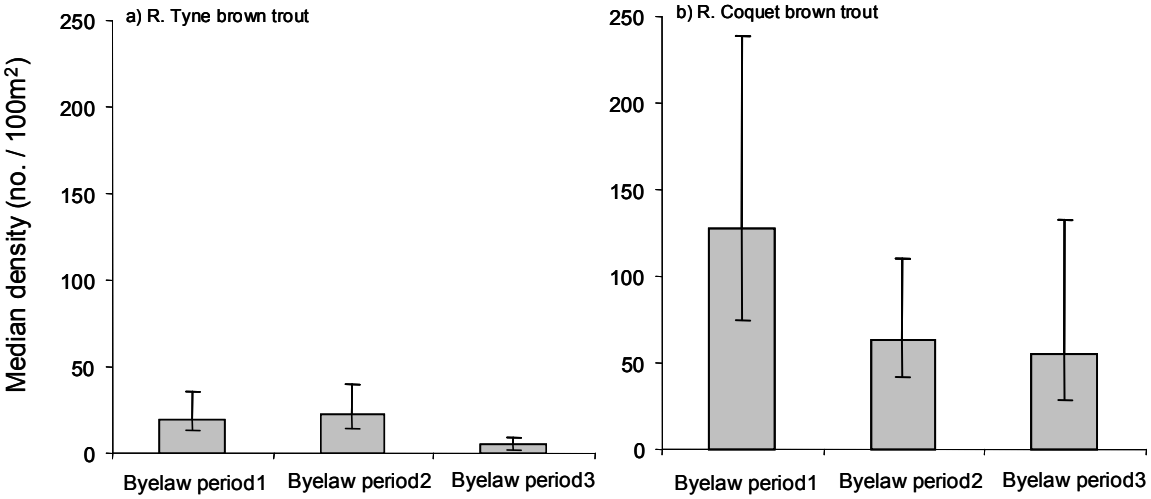


Figure 6. Median brown trout densities (no. / 100m^2) for three sites combined in a) the River Tyne and b) the River Coquet for each Esk byelaw period. Byelaw period 1 = 1989 to 1997, Byelaw period 2 = 1998 to 2002 and Byelaw period 3 = 2003 to 2010. Error bars are 95% Confidence Intervals. .

Changes in the salmonid composition on the River Tees also mirror that seen for two of the sites (ES1 and ES2) on the River Esk. In the River Tees there was a significant difference in salmonid composition over different byelaw periods ($H = 8.64$, $df = 2$, $p < 0.05$) with the proportion of brown trout decreasing (and therefore the proportion of salmon increasing) over the successive byelaw periods (Figure 7a).

There were no significant differences in salmonid composition over the three byelaw periods for any of the other North East rivers (i.e. Rivers Tyne, Wear and Coquet). However a significant difference in composition was seen when data from all North East rivers (and including the River Esk) was combined ($H = 9.58$, $df = 2$, $p < 0.01$). The combined analysis showed a decrease in the proportion brown trout compared to salmon in byelaw period three compared with period one (Figure 7b).

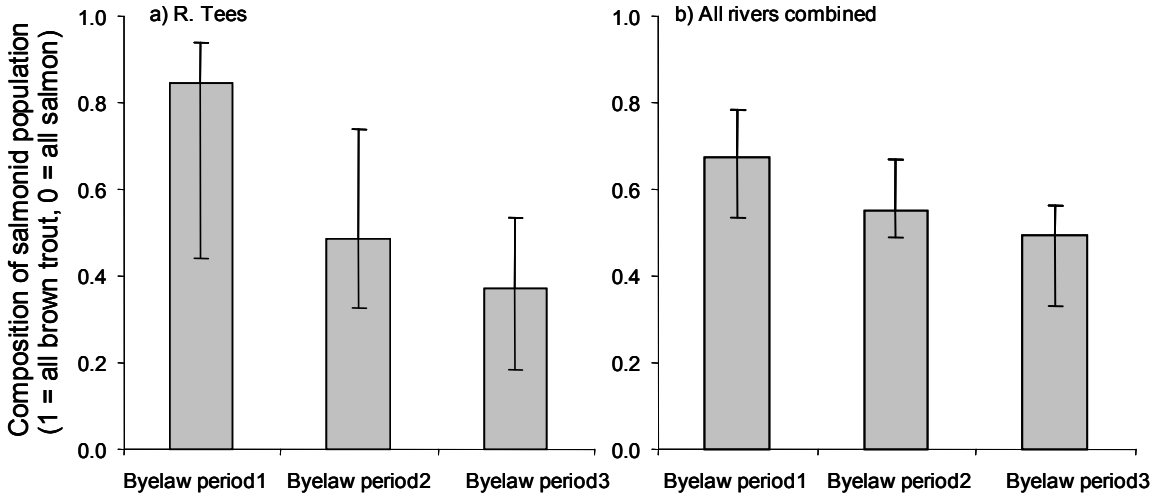


Figure 7. Composition of salmonid populations in a) the River Tees and b) all North East rivers combined including the River Esk, in each byelaw period. Byelaw period 1 = 1989 to 1997, Byelaw period 2 = 1998 to 2002 and Byelaw period 3 = 2003 to 2010. Error bars are 95% Confidence Intervals.

Appendix 3
Rod catch data

Analysis methods

Rod catch data comes from Environment Agency nationally collated rod licence information. Rod catch effort data is captured by the recording of Catch Per Licence Day (CPLD). These data include a measure of catch effort, which is needed to take account of large changes in the number of licences sold and the level of reporting that have occurred during the period of interest (i.e. pre- and post-Esk byelaw). These data are available from 1993 onwards and are the best available for examining rod catch on the River Esk and other North East rivers (supported by M Aprahamian. Pers. Comm.). These data have been used to examine whether there is any significant change in rod catch of salmon or sea trout over key time periods relevant to the Esk byelaw.

Extensive rod catch data for North East rivers exists going back over 100 years (although with no measure of effort). These data have been used to examine changes in the ratio of salmon to sea trout. A measure of effort is not required as long as an assumption is made that there is equal effort for both species of migratory salmonids. Therefore a longer data set was available to examine whether there is any significant change in the ratio of salmon to sea trout being caught over key time periods relevant to the Esk byelaw. The River Tees was excluded from this analysis since the recovering nature of this river (very low catches post 1987) made a comparison with other North East rivers unfair.

The time periods used for statistical analyses are shown in Table 1.

Table 1. Time periods used in statistical analyses

Period	Years	Reason
Byelaw period 1	1978 – 1986 *	Pre River Esk byelaw
Byelaw period 2	1987 – 1996**	Post byelaw, but ineffective due to loopholes
Byelaw period 3	1997 – 2001	Post amendments to close loopholes up to renewal
Byelaw period 4	2002 - 2009	From latest renewal to present***

* For examining ratio of salmon to sea trout only (longer data set available because measure of effort not required). ** For CPLD analyses, data was only available from 1993 – 1996 for Byelaw period 2. *** 2010 rod catch data was not available when the analyses were performed).

General linear models were used to examine differences in mean CPLD and mean salmon:sea trout, over the time periods outlined in Table 1. Analyses were performed in Minitab v15. Data sets did not show normal distributions and were therefore transformed. CPLD day data were transformed by taking the square root and salmon:sea trout data were transformed by taking logarithms ($\log_{10}$).

The Null Hypotheses (H_o) tested were:

- The mean rod catch (CPLD) of salmon/sea trout in each time period and each river is the same
- The mean rod catch (CPLD) of salmon/sea trout across time periods is the same for each river
- The mean ratio of salmon: sea trout in each time period and each river is the same
- The mean ratio of salmon: sea trout across time periods is the same for each river

Results

Rod catch (CPLD)

There was a significant difference in the mean rod catch (CPLD) of salmon between different rivers ($F = 28.1$, $df = 4$, $p < 0.001$; Figure 1a) and between different byelaw periods ($F = 43.5$, $df = 2$, $p < 0.001$; Figure 1b). Successive byelaw periods showed a significant increase in mean salmon rod catch (CPLD). The Rivers Esk, Tees and Wear showed no significant differences in terms of mean salmon rod catch (CPLD). The River Coquet though, did show a significantly greater mean salmon rod catch (CPLD), and mean catches on the River Tyne were highest of all (Figure 1b).

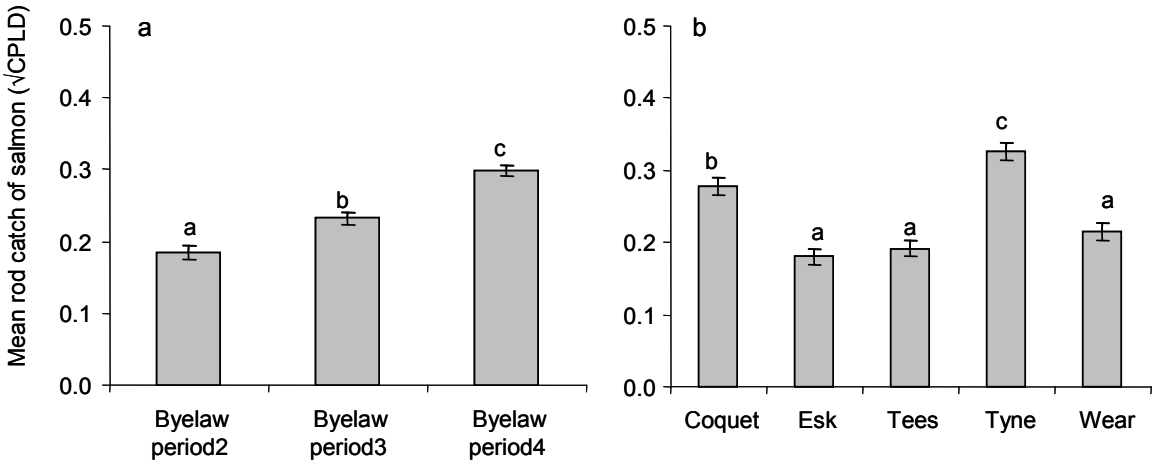


Figure 1. Mean rod catch (√CPLD) of salmon across a) different time periods relevant to the Esk bylaw and b) across different rivers. Byelaw period 2 = 1993 to 1996, Byelaw period 3 = 1997 to 2001 and Byelaw period 4 = 2002 to 2009. Error bars are ± 1 Standard Error. Bars with the same letter code are not significantly different.

There was no significant interaction in the General Linear Model between Esk byelaw period and rivers ($F = 0.9$, $df = 8$, $p > 0.05$) which means that all rivers were responding similarly across the three byelaw periods. Therefore mean salmon rod catches (CPLD) on the River Esk are not showing a pattern that is statistically distinguishable from any of the other North East rivers. However individual plots of mean salmon rod catch (CPLD) on each of the rivers (Figure 2) does show a gradual increase over the three time periods for all the north East rivers (Figures 2 b – e) - apart from the River Esk which shows a step change in byelaw period 4 compared with periods 2 and 3 (Figure 2 a; i.e. an increase since the last renewal of the byelaw in 2002).

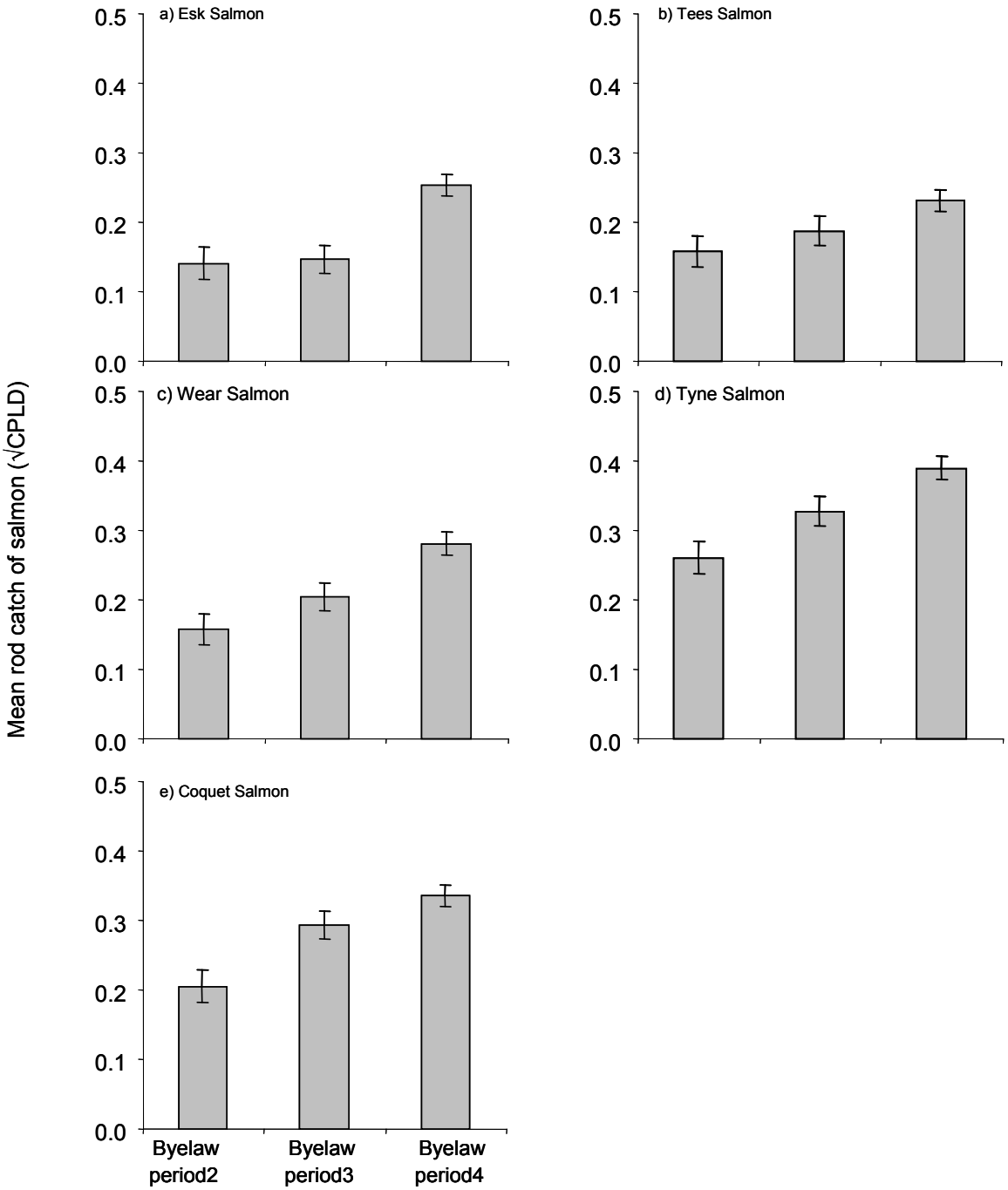


Figure 2 a – e. Mean rod catch (√CPLD) of salmon for each river across time periods relevant to the Esk bylaw. Byelaw period 2 = 1993 to 1996, Byelaw period 3 = 1997 to 2001 and Byelaw period 4 = 2002 to 2009. Error bars are ± 1 Standard Error.

There was a significant difference in the mean rod catch (CPLD) of sea trout between different rivers ($F = 171.2$, $df = 4$, $p < 0.001$; Figure 3 a) and between different byelaw periods ($F = 28.9$, $df = 2$, $p < 0.001$; Figure 3b). The River Tees had the lowest mean rod catch (CPLD) for sea trout and the River Esk had the highest. Overall the mean rod catch of sea trout was significantly higher in Esk byelaw period 3 and 4 compared with period 2. However, there was also a significant interaction between byelaw period and river ($F = 2.2$, $df = 8$, $p < 0.05$), which means that the pattern of change over time in mean sea trout rod catch (CPLD) is different on different rivers (See Figure 4).

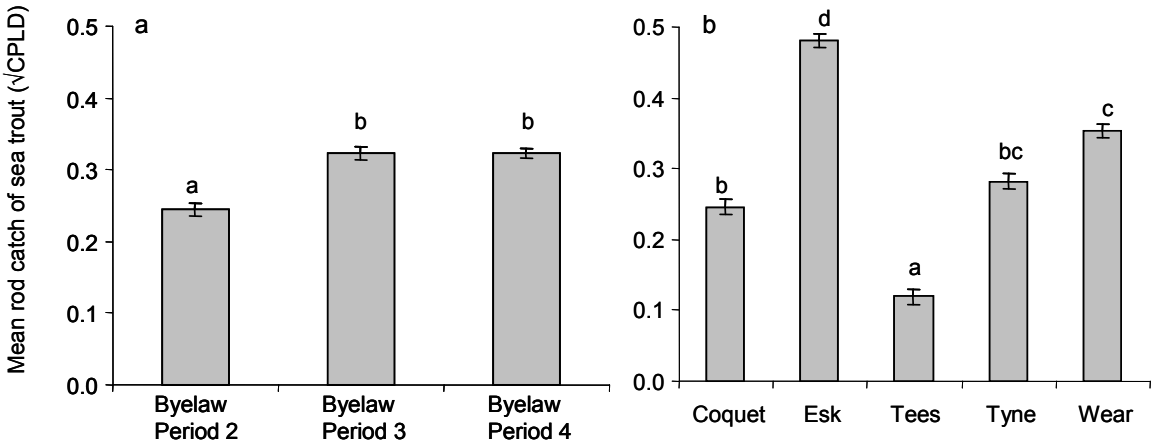


Figure 3. Mean rod catch (√CPLD) of sea trout across a) different time periods relevant to the Esk bylaw and b) across different rivers. Byelaw period 2 = 1993 to 1996, Byelaw period 3 = 1997 to 2001 and Byelaw period 4 = 2002 to 2009. Error bars are ± 1 Standard Error. Bars with the same letter code are not significantly different.

The Esk is the only river that shows a significant increase in mean sea trout rod catch (CPLD) between byelaw periods 3 and 4 compared with period 2 (Figure 4 a). The Rivers Tees and Wear both show a significant increase in mean sea trout rod catch (CPLD) in byelaw period 4 compared with period 2 (but not from byelaw period 3; Figures 4 b and c). However the Rivers Tyne and Coquet show no significant difference in mean sea trout rod catch (CPLD) across the three byelaw time periods (Figures 4 d and e).

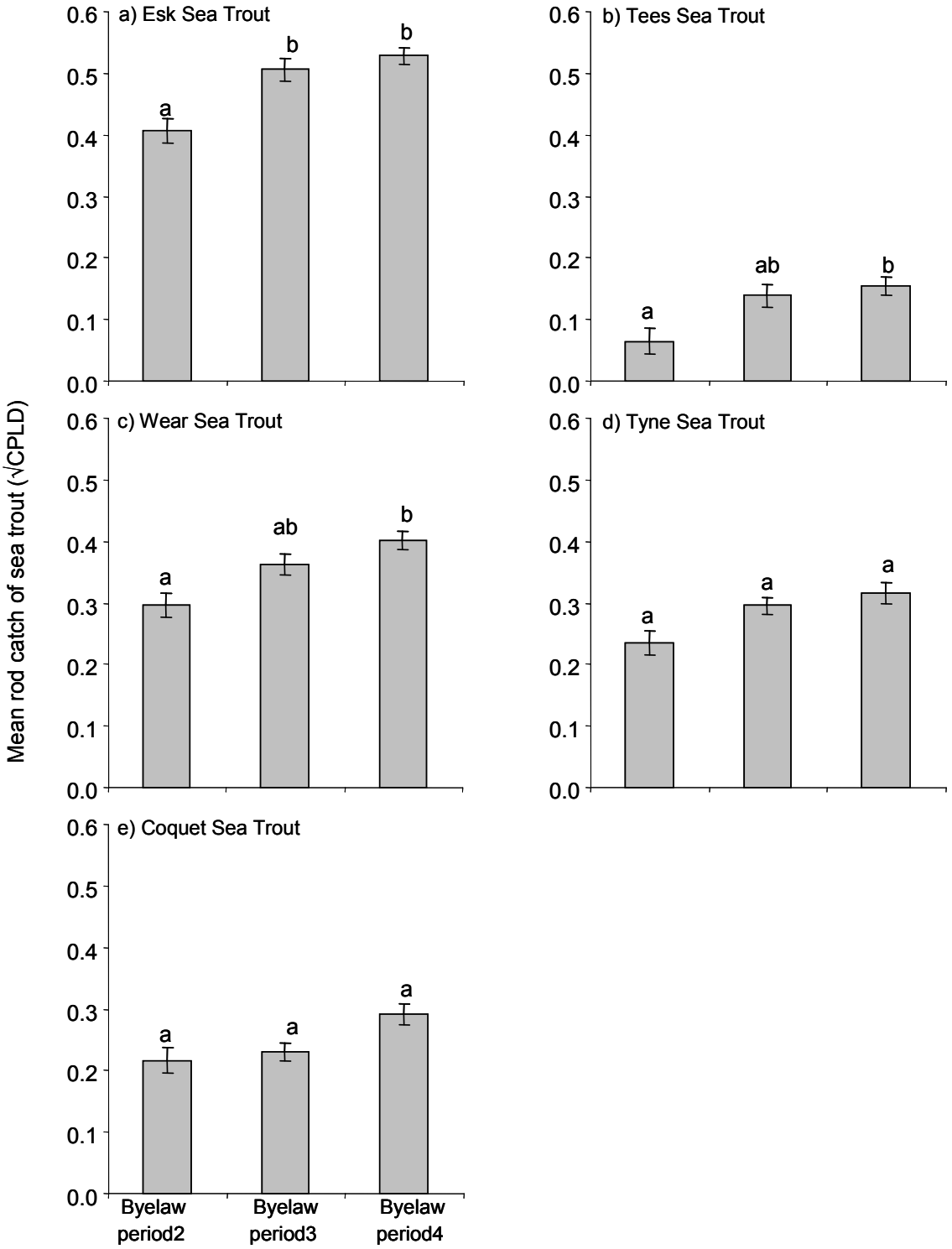


Figure 4 a – e. Mean rod catch (√CPLD) of sea trout for each river across time periods relevant to the Esk bylaw. Byelaw period 2 = 1993 to 1996, Byelaw period 3 = 1997 to 2001 and Byelaw period 4 = 2002 to 2009. Bars with the same letter code are not significantly different to each other. Error bars are ± 1 Standard Error.

Salmon:sea trout

There is a significant difference overall in the ratio of salmon to sea trout caught on different rivers ($F = 137.4$, $df = 3$, $p < 0.001$) and between different byelaw periods ($F = 17.2$, $df = 3$, $p < 0.001$; Figure 5 a – b). The mean salmon:sea trout ratio is significantly lower in byelaw periods 2 and 3 compared with periods 1 and 4 (Figure 5a). The lowest mean salmon:sea trout ratio is on the River Esk and the highest on the Rivers Coquet and Tyne (Figure 5b).

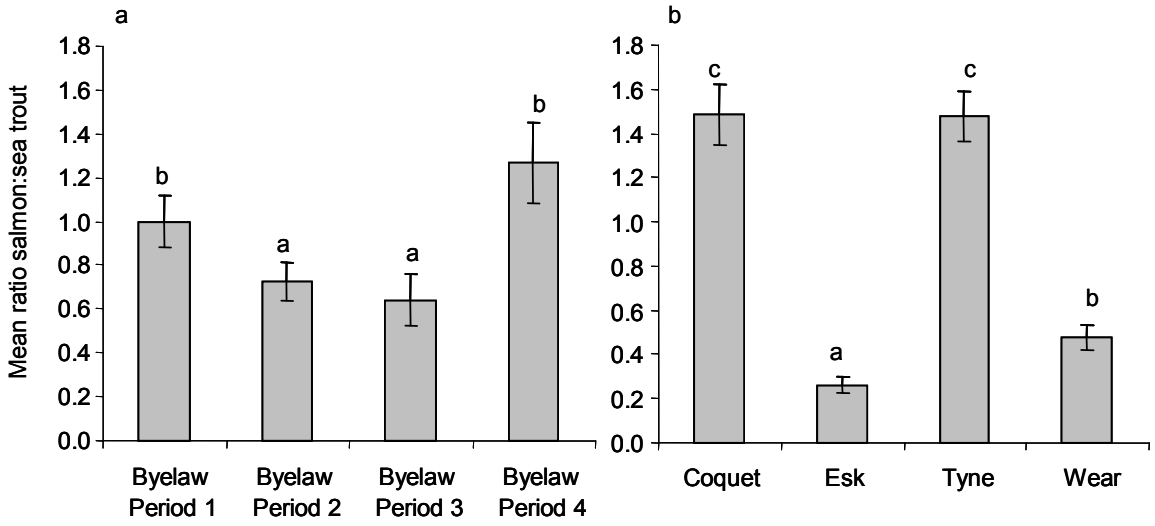


Figure 5. Mean ratio salmon:sea trout across a) different time periods relevant to the Esk bylaw and b) across different rivers. Byelaw period 1 = 1978 to 1986, Byelaw period 2 = 1987 to 1996, Byelaw period 3 = 1997 to 2001 and Byelaw period 4 = 2002 to 2009. Error bars are ± 1 Standard Error. Bars with the same letter code are not significantly different. Mean ratios are presented but analysis was performed on transformed data (Log_{10}).

There was also a significant interaction between byelaw period and rivers ($F = 4$, $df = 9$, $p < 0.001$), which means that the pattern of change in the mean salmon:sea trout ratio over time is different in different rivers (See Figure 6 a – d). For the River Esk the mean ratio of salmon:sea trout is significantly lower in byelaw periods 2 and 3 compared with periods 1 and 4 (Figure 6a). For the other North East rivers, while there was variation in the mean salmon:sea trout ratio across time periods (Figures 6 b – d), there were no significant changes at the individual river level.

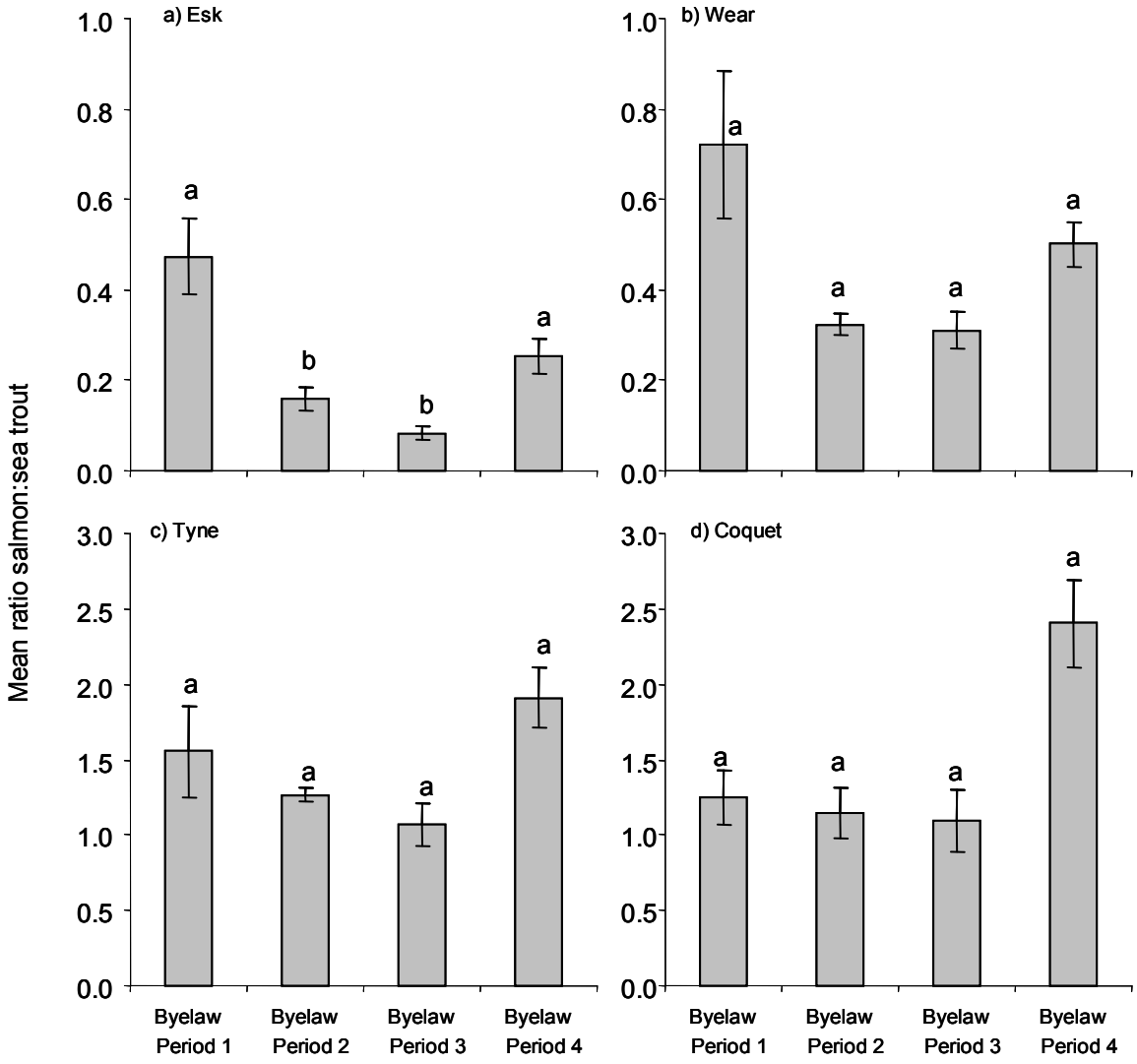


Figure 6 a – d. Mean salmon:sea trout ratio for each river across time periods relevant to the Esk bylaw. Byelaw period 1 = 1978 to 1986, Byelaw period 2 = 1987 to 1996, Byelaw period 3 = 1997 to 2001 and Byelaw period 4 = 2002 to 2009. Bars with the same letter code are not significantly different to each other. Error bars are ± 1 Standard Error. Mean ratios are presented but analysis was performed on transformed data (Log_{10}).

Appendix 4

Net Catch data

Analysis methods

We examined both Catch Per Unit Effort (CPUE) and total number of fish caught for salmon and sea trout. To determine CPUE, the number of fish caught per year was divided by the number of days fished, where one day fished related to one net set over one tide. We examined drift net and T/J net catches separately.

The distribution of the data was tested for normality using the Anderson Darling test. The data were checked for fulfilling the assumptions of the statistical test

Analysis was performed on transformed data (drift net data with natural logarithms, T/J net data with square root). Non-transformed data have been used for graphical representation of the patterns.

.All analyses were carried out using General Linear Models and Tukey Tests in Minitab v15. We built models that tested whether there was any significant difference in net catch between different time periods that are key to the implementation of the Esk Tideway byelaw and the subsequent buyout of drift nets as part of the North East Net Limitation Order (NLO) – See Table 1. We also tested whether there was a difference in net catch between different regions, Yorkshire and Northumbria, and whether net catches in the different regions were responding differently over the time periods.

Table 1. Time periods used in statistical analyses of net catch data.

Period	Years	Description
NLO 1	1993 - 1999	NLO phase out of drift nets, no potential influence of Esk byelaw on returning fish
NLO 2	2000 - 2002	NLO phase out of drift nets, potential influence of Esk byelaw on returning fish
NLO 3	2003 - 2009	Drift net buyout (2003), plus potential influence of Esk byelaw on returning fish

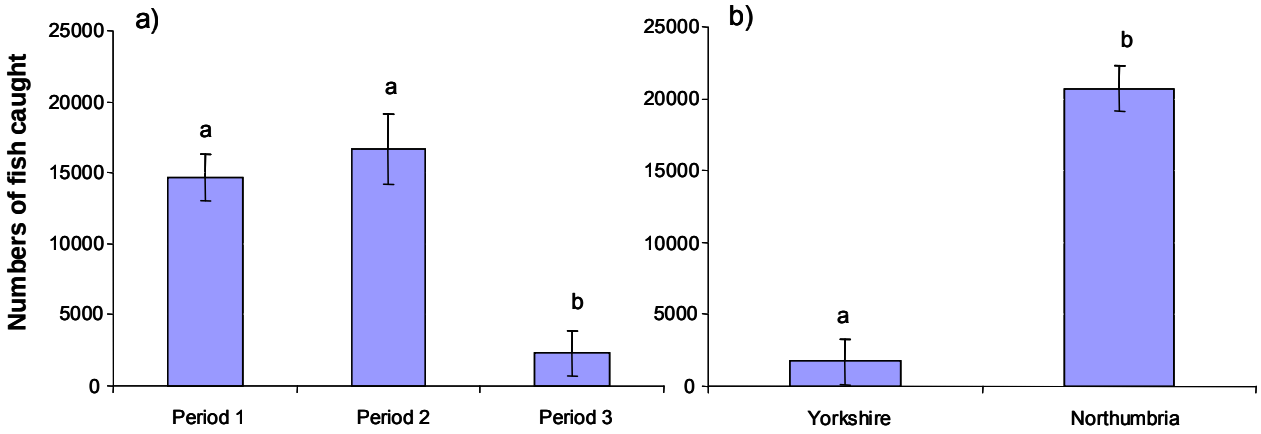
The Null Hypotheses (H_o) tested were:

- the mean net catch in each time period is the same
- the mean catch in each region is the same

Results

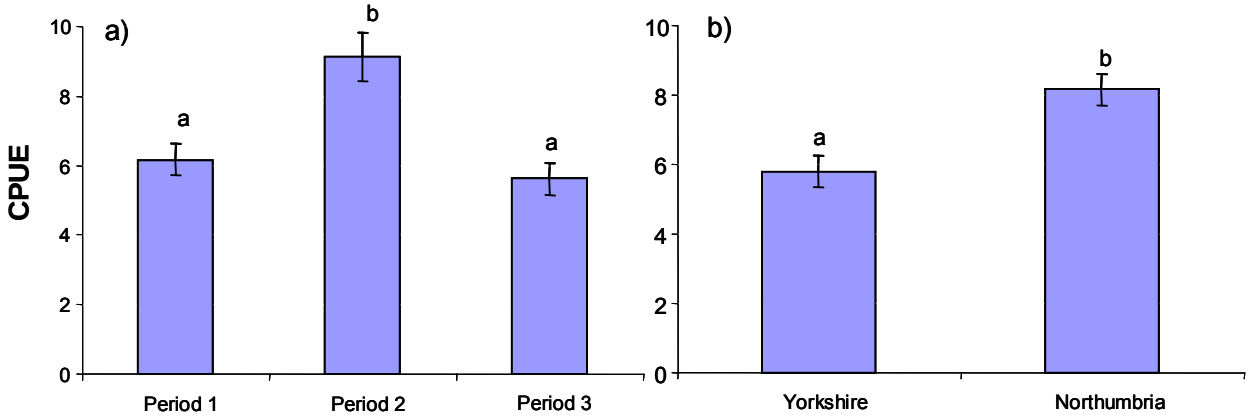
Drift Nets – Salmon

There was a significant difference between time periods ($F = 70.5$, $df = 2$, $p < 0.001$) and regions ($F = 232.6$, $df = 1$, $p < 0.001$) in the mean numbers of salmon caught in drift nets. The mean number of salmon caught overall in drift nets was significantly lower in period three compared with period one and two (See Figure 1 a). The mean number of salmon caught in Northumbrian drift nets was significantly greater than for Yorkshire (See Figure 1 b). However there was no significant interaction term ($F = 0.1$, $df = 2$, $p > 0.05$) which means that the overall pattern observed across time periods was the same for both regions (i.e. decrease in period three).



Figures 1a – b. Mean number of salmon caught in drift nets in a) each time period (Period 1 = 1993 to 1999, Period 2 = 2000 to 2002, Period 3 = 2003 to 2009) and b) each drift net area. Error bars are ±1 S.E. Bars with the same letter code are not significantly different ($p > 0.05$).

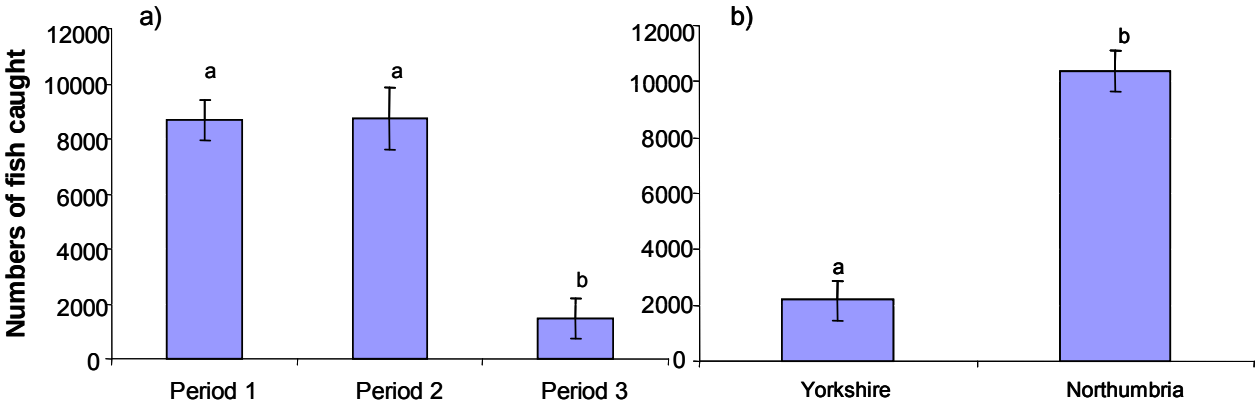
There was a significant difference between time periods ($F = 5.3$, $df = 2$, $p < 0.05$) and regions ($F = 9.9$, $df = 1$, $p < 0.01$) for the mean CPUE of salmon in drift nets. The mean CPUE for salmon overall in drift nets was significantly higher in period two compared with period one and three (See Figure 2 a). The mean CPUE for salmon in Northumbrian drift nets was significantly greater than for Yorkshire (See Figure 2 b). However there was no significant interaction term ($F = 0.23$, $df = 2$, $p > 0.05$) which means that the overall pattern observed across time periods was the same for both regions (i.e. increase in period two).



Figures 2a – b. Mean CPUE for salmon in drift nets in a) each time period (Period 1 = 1993 to 1999, Period 2 = 2000 to 2002, Period 3 = 2003 to 2009) and b) each drift net area. Error bars are ±1 S.E. Bars with the same letter code are not significantly different ($p > 0.05$).

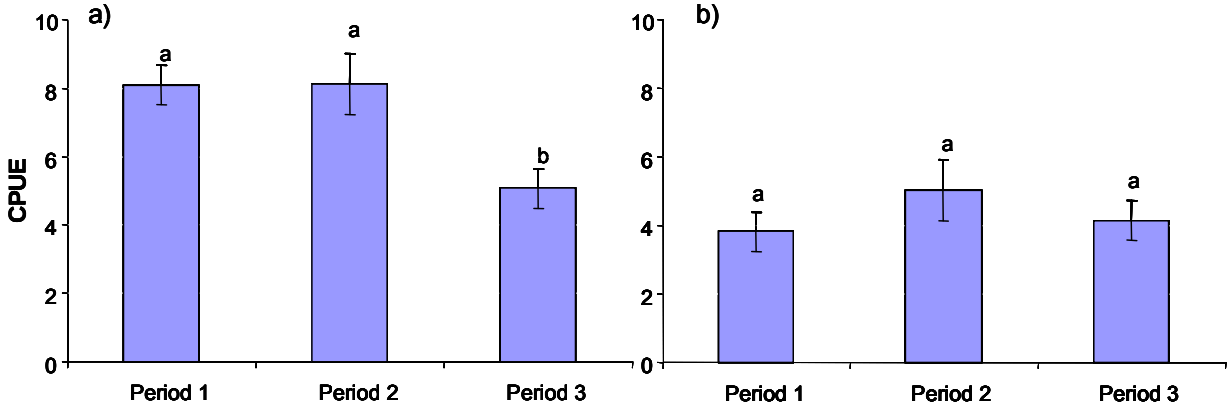
Drift Nets – Sea trout

There was a significant difference between time periods ($F = 119$, $df = 2$, $p < 0.001$) and regions ($F = 163$, $df = 1$, $p < 0.001$) in the mean numbers of sea trout caught in drift nets. The mean number of sea trout caught overall in drift nets was significantly lower in period three compared with period one and two (See Figure 3 a). The mean number of sea trout caught in Northumbrian drift nets was significantly greater than for Yorkshire (See Figure 3 b). However there was no significant interaction term ($F = 0.9$, $df = 2$, $p > 0.05$) which means that the overall pattern observed across time periods was the same for both regions (i.e. decrease in period three).



Figures 3a – b. Mean number of sea trout caught in drift nets in a) each time period (Period 1 = 1993 to 1999, Period 2 = 2000 to 2002, Period 3 = 2003 to 2009) and b) each drift net area. Error bars are ±1 S.E. Bars with the same letter code are not significantly different ($p > 0.05$).

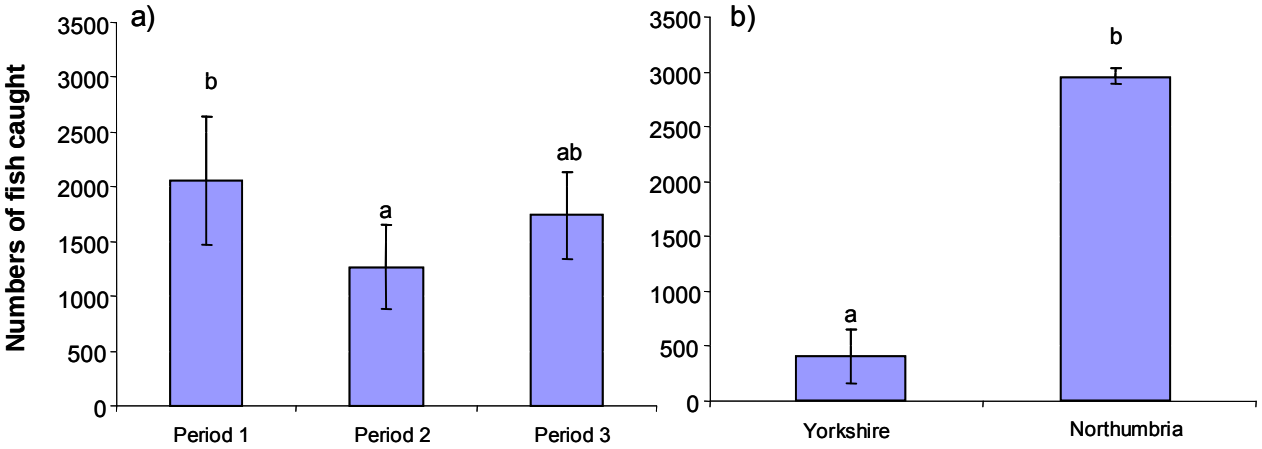
There was a significant difference between time periods ($F = 4.6$, $df = 2$, $p < 0.05$) and regions ($F = 20.2$, $df = 1$, $p < 0.001$) for the mean CPUE of sea trout in drift nets. There was also a significant interaction term ($F = 4.02$, $df = 2$, $p < 0.05$) which means that the pattern across time periods was different for the two separate regions. In Yorkshire there was a significant decrease in CPUE for sea trout in drift nets in period three compared to periods one and two (See Figure 4 a). However there were no significant differences in mean CPUE for sea trout in the Northumbria drift nets across the time periods (See Figure 4 b).



Figures 4a – b. Mean CPUE for sea trout in drift nets across each time period (Period 1 = 1993 to 1999, Period 2 = 2000 to 2002, Period 3 = 2003 to 2009) in a) Yorkshire area and b) Northumbria area. Error bars are ±1 S.E. Bars with the same letter code are not significantly different ($p > 0.05$).

T/J Nets – Salmon

There was a significant difference between time periods ($F = 3.5$, $df = 2$, $p < 0.05$) and regions ($F = 144$, $df = 1$, $p < 0.001$) in the mean number of salmon caught in T/J nets. The mean number of salmon caught overall in T/J nets was significantly lower in period two compared with period one (See Figure 5 a). The mean number of salmon caught in Northumbrian T/J nets was significantly greater than for Yorkshire (See Figure 5 b). However there was no significant interaction term ($F = 0.7$, $df = 2$, $p > 0.05$) which means that the overall pattern observed across time periods was the same for both regions (i.e. decrease in period two compared with period one).



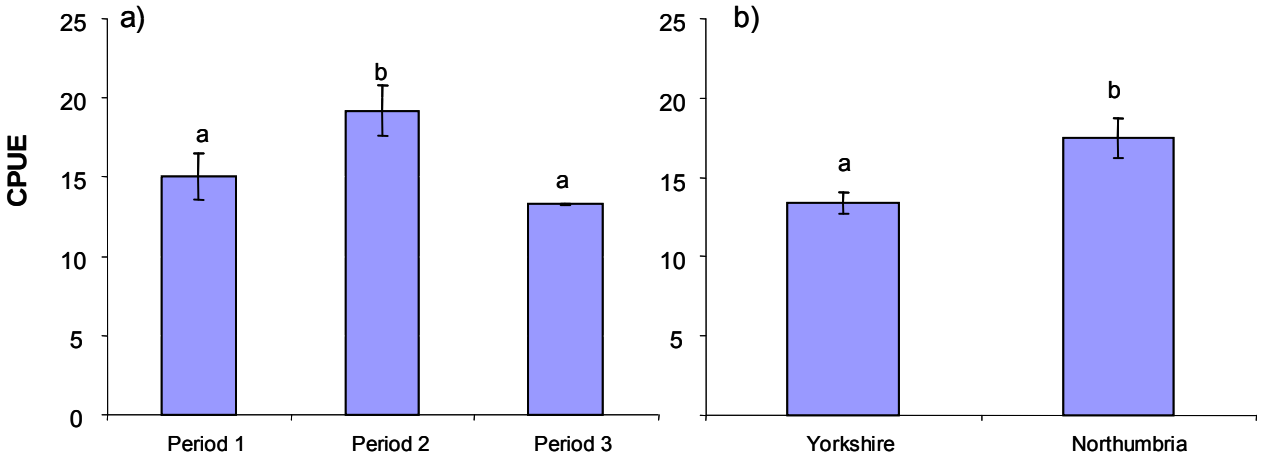
Figures 5a - b. Mean number of salmon caught in T/J nets in a) each time period (Period 1 = 1993 to 1999, Period 2 = 2000 to 2002, Period 3 = 2003 to 2009) and b) each drift net area. Error bars are ±1 S.E. Bars with the same letter code are not significantly different ($p > 0.05$).

The only significant difference for the CPUE of salmon in T/J nets was between regions ($F = 234$, $df = 1$, $p < 0.001$), with mean CPUE for Northumbrian nets being significantly higher than for Yorkshire nets. There were no significant differences between different time periods ($F = 1.1$, $df = 2$, $p > 0.05$).

T/J Nets – Sea trout

There were no significant differences across time periods ($F = 1.4$, $df = 2$, $p > 0.05$) or between regions ($F = 0.3$, $df = 1$, $p > 0.05$) for the mean number of sea trout caught in T/J nets.

There was a significant difference between time periods ($F = 9.8$, $df = 2$, $p < 0.001$) and between regions ($F = 13.6$, $df = 2$, $p < 0.001$) for the CPUE for sea trout in T/J nets. The mean CPUE of sea trout was significantly higher overall in period two compared with periods one and three (See Figure 6 a). The mean CPUE of sea trout was significantly higher in Northumbrian T/J nets than in Yorkshire nets (See Figure 6 b). However, there was no significant interaction term ($F = 0.4$, $df = 2$, $p > 0.05$) which means that the overall pattern across the time periods was the same for both regions (i.e. increase in period two).



Figures 6a - b. Mean CPUE for sea trout in T/J nets in a) each time period (Period 1 = 1993 to 1999, Period 2 = 2000 to 2002, Period 3 = 2003 to 2009) and b) each drift net area. Error bars are ±1 S.E. Bars with the same letter code are not significantly different ($p > 0.05$).

Appendix 5

Rod Catches of Salmon (S&G) and Sea Trout (ST) from the River Esk (Yorkshire)

Year	S&G	ST	Year	S&G	ST	Year	S&G	ST	Year	S&G	ST
1867			1906	235		1945	29	49	1984	39	256
1868			1907	117	98	1946	200	118	1985	104	207
1869			1908	51	105	1947	31	25	1986	65	130
1870			1909	241	159	1948	299	88	1987	70	299
1871			1910	304	219	1949	5	13	1988	49	279
1872			1911	86	137	1950	129	39	1989	11	97
1873			1912	386	171	1951	157	157	1990	14	162
1874			1913	119	98	1952	90	143	1991	11	103
1875	5	62	1914	111	41	1953	169	157	1992	42	125
1876	5	82	1915	248	62	1954	185	254	1993	25	214
1877	358		1916	226		1955	199	1	1994	118	485
1878	15	140	1917	526	64	1956	608	542	1995	32	305
1879	20	271	1918	350	48	1957	333	342	1996	14	211
1880	57	180	1919	374	58	1958	437	414	1997	45	395
1881	120	160	1920	346	47	1959	58	207	1998	35	522
1882	101	82	1921	200	1	1960	593	564	1999	19	507
1883	160	171	1922	744	4	1961	249	328	2000	44	564
1884	107		1923	442	27	1962	542	415	2001	33	276
1885	573		1924	958	53	1963	339	486	2002	57	519
1886	522		1925	300	53	1964	219	545	2003	43	479
1887	435		1926	164	46	1965	924	640	2004	189	489
1888	397		1927	767	109	1966	654	506	2005	111	376
1889	413		1928	340	54	1967	492	558	2006	197	552
1890	335		1929	216	30	1968	379	358	2007	145	672
1891	1346		1930	389	61	1969	363	182	2008	159	493
1892	740		1931	208	75	1970	166	110	2009	52	206
1893	929		1932	245	112	1971	332	138	2010	177	767
1894	557		1933	83	43	1972	156	143			
1895	885		1934	57	75	1973	424	304			
1896	604		1935	266	47	1974	197	421			
1897	350		1936	153	43	1975	134	220			
1898	191		1937	67	20	1976	202	726			
1899	458		1938	155	70	1977	178	466			
1900	486		1939	149	46	1978	238	228			
1901	131		1940	130	72	1979	84	153			
1902	413		1941	130	71	1980	154	448			
1903	258		1942	80	40	1981	162	320			
1904	315		1943	57	28	1982	113	340			
1905	138	115	1944	144	79	1983	48	146			

Appendix 6

ENVIRONMENT AGENCY – YORKSHIRE AND NORTH EAST REGION

MINUTES OF A MEETING OF REGIONAL FISHERIES, ECOLOGY AND RECREATION ADVISORY COMMITTEE HELD AT PHOENIX HOUSE, LEEDS ON WEDNESDAY, 24 FEBRUARY 2010 AT 10.00 AM

PRESENT:
Mr D Stewart OBE (Chairman)

Mr R Broadbent	Mr C Hawkesworth	Mr K Sunderland
Mr I Brown	Miss J Moxon	
Mr C Dennison	Mrs K McLoughlin	
Mr C Evans	Mr I Oates	
Mr J Hart-Woods	Mrs M Pletts	
Mr M Hopper	Mr S McPherson	

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10/10 RIVER ESK BYELAW RENEWAL [RFERAC/694]

Members supported the renewal of the Byelaw

The Strategy Manager submitted a report seeking the Committee's support for the renewal of the River Esk Tideway Byelaw. Ollie Foster from the River Esk Action Committee was in attendance and, with the permission of the meeting, gave a statement in support of the proposals in the paper. He outlined concerns about the hydropower scheme at Ruswarp Weir, but he hoped that adequate monitoring would help to put the Action Committee's mind at rest. He also emphasised the need for adequate liaison between the Environment Agency's fisheries department and those involved in giving authorisations for hydroelectric schemes. The Regional Director said that hydropower was an emerging issue in which the Agency had an obligation to play a part in ensuring that the environment was protected. He had allocated a management lead for this and accepted that there needed to be a mechanism for involving RFERAC in the process (see also Minute 14/10 c)). The Regional Board Member said that the growth in hydropower applications need to be looked at in the context of a 15% renewable energy target by 2015 but he emphasised the importance of preventing any damage to the environment.

Resolved
It was resolved to support the renewal of the River Esk Tideway Byelaw.

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Appendix 7

ENVIRONMENT AGENCY

WATER RESOURCES ACT 1991
ENVIRONMENT ACT 1995

SALMON AND FRESHWATER FISHERIES ACT 1975

FISHERIES BYELAWS

The Environment Agency, in exercise of its powers under Section 210 and Schedule 25 to the Water Resources Act 1991 and all other powers enabling it in that behalf, makes the following Byelaw.

Prohibition of Fishing on the River Esk Below Ruswarp Weir

(1) The provisions of Byelaw numbered 22 made by the Yorkshire Ouse and Hull River Authority on 25th January 1967 and confirmed on 26th October 1967 shall apply to this Byelaw.

(2) No person shall fish for, take or attempt to take by any means, any fish from that part of the River Esk lying between Ruswarp Weir and a line drawn due west across the river from the southernmost end of Eskside Wharf, Whitby (NGR NZ 902105) except that it shall be permitted to fish for sea fish with rod and line on the said part of the River Esk from 6.00am to 8.00pm or until one hour after sunset, whichever is earlier.

(3) These Byelaws shall come into effect on 13 February 2012

THE COMMON SEAL OF THE
ENVIRONMENT AGENCY

was affixed on the day of 2011

in the presence of :

AUTHORISED SIGNATORY