

Unique Document No: 5191

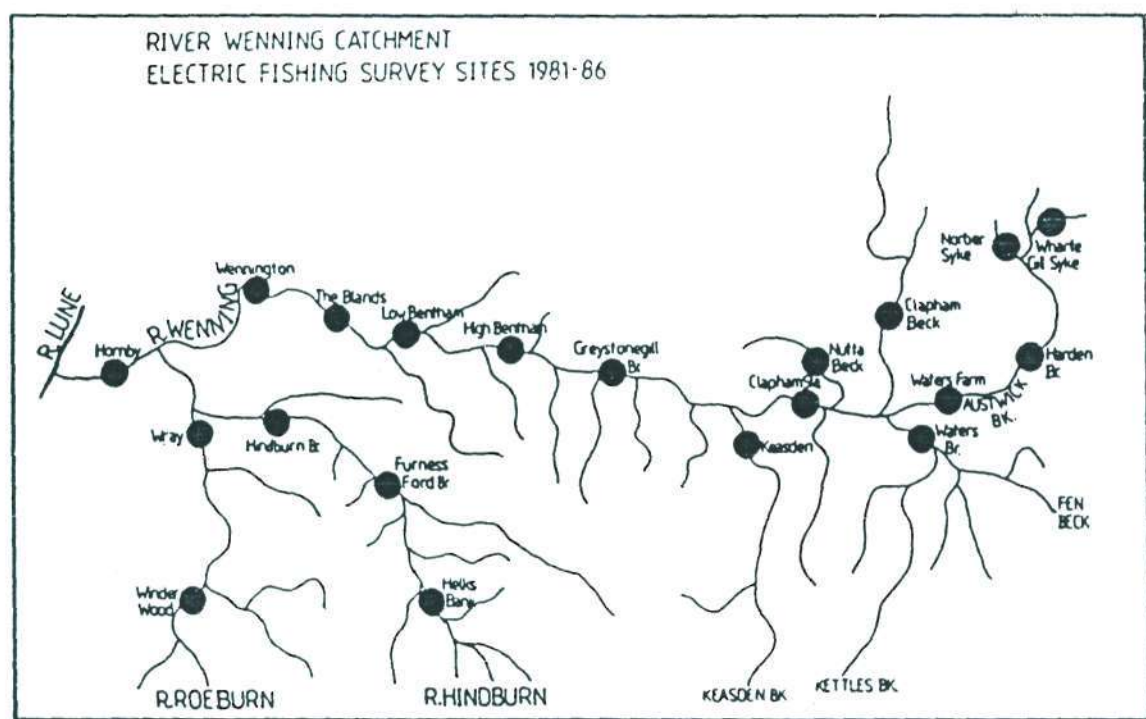
UDC Class No: 639.2.081.19
Keywords: JUVENILE SALMONID,
TROUT,

Annotations:

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RICHT BIOLOGY
LABORATORY (CENTRAL)
ENVIRONMENTAL PROTECTION

JUVENILE SALMONID INVESTIGATIONS RIVER WENNING CATCHMENT 1981-86



REPORT BC.87.4.
BRIAN INGERSENT.

RIVER WENNING CATCHMENT ELECTROFISHING RESULTS 1981-86

SUMMARY

As part of the River Lune juvenile salmonid investigation, a number of sites on the River Wenning catchment were electrofished annually from 1981 - 1985. Particularly low Salmon parr populations were evident for much of the Wenning catchment which has caused some concern. All the Wenning catchment electrofishing results are reported in this paper and comparisons are made with designated groups of sites on the remainder of the Lune catchment. These groups of sites (as designated by Fisheries) are: R. Lune and tribs. u/s Tebay, Upper Middle Lune, Lower Middle Lune, Lower Lune, Birk & Borrow Becks, Chapel & Crosdale Becks, Rawthey system, Barbon & Leck Becks and the Greta system.

Mean density estimates for Total Salmonids for both 0+ and 1++ age classes on the Wenning catchment are generally lower than most groups of Lune catchment sites. In terms of 0+ Salmon, the mean density for the Wenning catchment is lower than any other group of Lune catchment sites and the mean density estimate for 1++ Salmon on the Wenning catchment is lower than the mean density estimates for all Lune catchment sites except the lower main River Lune. In contrast, the mean density estimates for both 0+ and 1++ Trout on the Wenning catchment are better than most Lune catchment groups of sites. Most Lune catchment sites have a higher ratio of Salmon to Trout but the opposite is the case for both 0+ and 1++ fish on the Wenning catchment. The ratio of 0+ to 1++ Salmon on the Wenning catchment appears to fall within the 'typical range' for the Lune catchment.

The general scarcity of Salmonids in large sections of the main river Wenning probably reflects the apparent limited natural spawning areas on the catchment. Details of Salmon fry and ova planting on the Wenning catchment since 1981 have been collated and whilst survival through the 0+ stage appears to be quite good, recruitment to the 1++ stage appears to be poor. Water quality does not appear to be responsible for the very low salmonid densities at some main river sites but is possibly a factor in apparently preventing any Salmon run in Keasden Beck. Recommendations for future Fisheries and Biological work are given.

INTRODUCTION

The Wenning catchment has been electrofished annually each summer between 1981-85 as part of the River Lune juvenile salmonid investigation. With only slight changes, the same sites have been sampled each year by very largely the same sampling team which should have reduced any operating differences. From early on it became clear that salmonid populations over a long stretch of the main river Wenning in particular were very low and that salmon parr recruitment was particularly poor. During the survey period, major land drainage works, 'The Austwick Scheme', were undertaken at the upper end of the Wenning and Austwick, Clapham, Fen and Kettles Becks between September 1982 and May 1984. Surveys undertaken in 1981 and 82 were therefore prior to the commencement of the scheme, the 1983 survey during the major part of the scheme and 1984 and 85 surveys following completion of the scheme. Only limited electric fishing was carried out in 1986, principally to check for survival of salmon fry from fry and ova planting. The sites surveyed during the sampling programme were as follows :-

<u>RIVER</u>	<u>SITE</u>	<u>GRID REF</u>	<u>YEARS SAMPLED</u>
AUSTWICK BECK	Harden Bridge	SD 761 678	1982-85
" "	Waters Farm	SD 749 676	1982 & 1985
FEN BECK	Waters Bridge	SD 754 668	1982, 84 & 85
CLAPHAM BECK	d/s A65 Bridge	SD 744 685	1981-85
KEASDEN BECK	Nr. Keasden	SD 717 666	1982-85
RIVER WENNING	Clapham Station	SD 739 678	1981-86
" "	Greystonegill	SD 694 682	1981-86
" "	High Bentham	SD 664 688	1982-85
" "	Low Bentham	SD 646 693	1982-85
" "	The Blands	SD 631 700	1982-85
" "	Wennington	SD 614 702	1981-85
" "	Hornby	SD 582 684	1981-85
RIVER HINDBURN	Helks Bank	SD 652 639	1981-85
" "	Furness Ford Bridge	SD 635 670	1981-85
" "	Hindburn Bridge	SD 611 675	1981-85
RIVER ROEBURN	Winder Wood	SD 603 638	1981-85
" "	Wray	SD 604 672	1981-85
WHARFE GILL SYKE	Nr. Austwick	SD 778 693	1986
NORBER SYKE (WHITE BECK)	d/s Austwick Road	SD 775 692	1986
NUTTA BECK	u/s Clapham Station	SD 726 688	1986

(See Map)

GENERAL FISHERIES INFORMATION

The Wenning and its major tributaries, the Hindburn and Roeburn, are principally Sea Trout rivers with a resident Brown Trout population, but a reasonable number of Salmon do appear to come into the system. Salmon spawning is more or less confined to the upper end of the Wenning system (Clapham Station and above) with a small number spawning at Hindburn foot. Similarly the main

area of Sea Trout spawning is at and above Clapham Station, with smaller numbers spawning in the Hindburn and Roeburn systems. (See Map). Redd counts in 1984 and 1985 were 57 and 30 respectively for Salmon and 198 and 234 respectively for Sea Trout. Approximate angling returns appear to show a decline in catches between 1985 and 86 for both Salmon and Sea Trout :- 5 Salmon were caught in 1985 and only one caught in 1986, and approximately 450 Sea Trout were caught in 1985 and approximately 250 caught in 1986 (of which approximately 150 were on the Hindburn system).

Artificial stocking of salmon fry/ova has in recent years been largely confined to the upper Wenning system, although in 1986 the top end of the Roeburn was stocked, and in 1982 the main river Wenning above Wennington and the river Hindburn at Wray were stocked. Since 1980, the following programme of fry and ova planting has been carried out :-

- May 1980 11,000 fed Sea Trout fry into R. Wenning, u/s and d/s of Greystonegill Bridge
- May 1980 11,000 fed Sea Trout fry into R. Hindburn, Stain End Bridge area
- April 1982 80,000 unfed Salmon fry into R. Wenning above Wennington
- April 1982 80,000 unfed Salmon fry into R. Wenning, u/s and d/s of Greystonegill Bridge
- April 1982 40,000 unfed Salmon fry into R. Hindburn, Wray area
- May 1983 50,000 fed Salmon fry into R. Wenning, u/s and d/s of Greystonegill Bridge
- May 1984 50,000 unfed Salmon fry into R. Wenning, u/s and d/s of Greystonegill Bridge
- May 1985 20,300 unfed Salmon fry into Austwick Beck above Wharfe
- May 1985 20,000 unfed Salmon fry into R. Wenning, u/s and d/s of Greystonegill Bridge
- Spring 1986 5,000 eyed Salmon ova into Norber Syke (White Beck)
- Spring 1986 5,000 eyed Salmon ova into Wharfe Gill Syke
- Spring 1986 27,000 fed salmon fry into R. Roeburn, Winder Wood area

GENERAL WATER QUALITY INFORMATION

The Wenning catchment is regularly biologically monitored as part of the Lune catchment River Protection Survey. On the last survey undertaken in July 1986, all sites on the survey were biologically inferred N.W.C. Class 1A or 1B, i.e. good water quality was indicated. It is likely that more biological sampling sites will be included in 1987 surveys for the Wenning catchment. Past water quality problems have been investigated from a number of sources on the catchment, including Angus Fire Armour at High Bentham, the fish farm at Low Bentham, small chlorinating plants run by Yorkshire Water Authority in the Austwick area and farm pollution problems notably from the Lawkland area on Fen Beck. The Austwick Scheme obviously caused some water quality deterioration at times, particularly with silt loading downstream. However, biological monitoring indicated good recovery of benthic invertebrates at sites within the area of the scheme and little effect on the main River Wenning sites downstream of the scheme. The site most affected by siltation appeared to be Fen Beck at Waters Bridge, although organic pollution from Lawkland also restricted the fauna. (See Biological Report BN 80 (11/84)).

ELECTROFISHING SAMPLING METHODS AND DETERMINATION OF RESULTS

Standard electrofishing techniques using D.C. gear were applied to sites of approximately 30 to 50m length. Sites were fished twice with fish caught during the first fishing excluded from the sample area during the second fishing. All salmonids caught were measured to the nearest centimetre.

The sample site length was measured and mean channel width determined to give a value for the area surveyed. Population estimates were calculated using the Seber and Le Cren two catch formula :-

$$N = \frac{C_1^2}{(C_1 - C_2)}$$

where N = estimated number of fish
C₁ = no. of fish in the first fishing
C₂ = " " " " " second "

From the data, age classes were determined for both salmon and trout, and these are reported as :-
0+ Salmon (fry of the year)
0+ Trout (fry of the year)
1++ Salmon (parr, 1 year or older but not adult fish)
1++ Trout (1 year or older, but not adult Sea Trout)

It is likely that some 0+ Trout and possibly some 1++ Trout will in fact be Sea Trout.

Numbers were estimated for each age class and species and reported as a density estimate, in this report as number of fish/100m².

As a rough guide, the 'normal range' of salmonid density can be described as follows :-

	<u>Bad</u>	<u>Poor</u>	<u>Satisfactory</u>	<u>Very Good</u>	<u>Excellent</u>
Total 0+ Salmonids (No/100m ²)	<10	10-20	21-40	41-70	>70
Total 1++ Salmonids (No/100m ²)	<10	10-13	14-26	27-50	>50

(See forthcoming report by B. Williams)

RESULTS AND DISCUSSION

As well as site by site discussion of results for the Wenning catchment, comparisons are made with the remainder of the River Lune catchment. For the purposes of reporting the River Lune catchment results, ten groups of sites have been designated by Fisheries :-

River Lune and tributaries, u/s Tebay
Upper Middle Lune (Low Borrow Bridge - Broadrairie)
Lower Middle Lune (Killington - Kirkby Lonsdale)
Lower Lune (Whittington - Caton)
Birk Beck and Borrow Beck
Minor Upper-mid Lune tributaries (Chapel and Crosdale Becks)
Rawthey system (including Clough and Dee)
Minor mid-Lune tributaries (Barbon and Leck Becks)
Greta system
Wenning system (including Roeburn and Hindburn)

In view of the interest on the main river Wenning, the Wenning system results have been re-worked to also give results for the 'Wenning Main River' (Hornby - Clapham Station), and this group of sites will be included in the results.

The summary of the river Lune catchment electrofishing results is given in Appendix 1. The means are calculated from results recorded between 1981 and 1985 for Salmon, and 1981 and 1984 for Trout (the 1985 Trout results were not in a readily accessible form). The Wenning results also include those results from the 1986 sampling where those sites had previously been included in the Lune catchment study (River Wenning at Clapham Station and Greystonegill, and the River Roeburn at Winder Wood).

TOTAL 0+ SALMONIDS

In terms of 0+ Salmonids, the mean density estimate for the Wenning catchment is 17.22/100m² which can be regarded as being fairly poor. This density estimate is slightly better than the mean estimates for the Upper Middle Lune, Lower Middle Lune and Lower Lune group of sites, but lower than all other groups of sites on the Lune catchment. The best result for the Lune catchment is a mean density estimate of 190.38 0+ Salmonids/100m² on Chapel and Crosdale Becks, an excellent result. Apart from the Greta system which is only slightly better than the Wenning catchment estimate, all other estimates on the Lune catchment are between 35.45 and 65.01 0+ Salmonids/100m². The main river Wenning density estimate of 16.32/100m² is only slightly less than the Wenning catchment as a whole.

TOTAL 1++ SALMONIDS

A similar order of comparison is evident for the Wenning catchment in terms of total 1++ salmonid density estimates. The mean density estimate for the Wenning catchment is 7.42/100m² ('Bad') which is higher than the Upper Middle, Lower Middle and Lower Lune groups of sites, but below all other groups of sites which are between 9.41 1++ salmonids/100m² (Greta system) and 34.63 1++ salmonids/100m² (Chapel and Crosdale Becks). The density estimate for the main river Wenning is 6.93 1++ salmonids/100m² which is slightly poorer than the mean estimate for the Wenning catchment as a whole.

The mean 1++ salmonid density estimates for the Lune catchment can only be regarded as 'good' or 'satisfactory' at three groups of sites :- Birk and Borrow Becks (14.49/100m²), Barbon and Leck Becks (17.20/100m²) and Chapel and Crosdale Becks (34.63/100m²).

Appendix 2 shows the ranking of River Wenning catchment sites based on mean total 1++ salmonid densities, 1981 - 85. Only four of the seventeen sites can be regarded as 'satisfactory' and at all these sites, trout are very much the dominant species. Two sites can be regarded as 'poor', again both were trout dominated. The remaining eleven sites can be regarded as 'bad', with the river Wenning at Hornby the only site dominated by salmon.

0+ SALMON

The mean density estimate of 5.37 0+ salmon/100m² for the Wenning catchment is the lowest for any of the Lune catchment sites. The mean density estimate for the main river Wenning sites is better at 9.43/100m² but still lower than any other Lune catchment site. The best mean density estimate for the Lune catchment is again for Chapel and Crosdale Becks at 60.85/100m² with the mean density estimates also very good for Barbon and Leck Becks at 50.86/100m². For the Wenning catchment, the best mean density estimate for 0+ Salmon is the main river at Clapham Station at 35.07/100m², although this figure is boosted by a noteworthy density estimate in 1984 of 134.19/100m². From the limited survey work done in 1986, the site on Norber Syke gave a density estimate of 66.15/100m², which is in fact better than the mean density estimates

for the best Lune catchment sites. Of the seven main river Wenning sites regularly surveyed, two sites have never had O+ Salmon recorded :- Low Bentham and the Blands. The site at High Bentham only had O+ salmon recorded in 1982. This reflects the apparent limited spawning areas available on the Wenning.

1++ SALMON

Apart from very poor results on the Lower Lune main river (mean density estimate of 0.45/100m²), the mean density estimate for the Wenning catchment at 1.39/100m² is the lowest for the Lune catchment. The best mean density estimates are again for Chapel and Crosdale Becks at 17.40/100m² and Barbon and Leck Becks at 12.24/100m². Again the main river Wenning group of sites is slightly better than the mean density estimate for the Wenning catchment, but at 1.87/100m² is still much lower than most Lune catchment sites.

Appendix 3 shows the ranking of Wenning catchment sites based on mean 1++ salmon density estimates 1981 - 85. The best site is the Wenning at Hornby with a mean density estimate of 5.52/100m², slightly less than the mean density estimates for the Greta and Rawthey systems. Less than half of the Wenning catchment sites have mean density estimates greater than 1.00/100m². Four sites have not had 1++ salmon recorded, two on the river Hindburn are upstream of an impassable obstruction, one site on Fen Beck has probably been affected by a combination of silting due to the Austwick Scheme and organic pollution from the Lawkland area, but the absence of salmon (O+ and 1++) in Keasden Beck is something which warrants further investigation. This beck is accessible to salmon and is not far downstream of the main spawning area on the Wenning and one might expect salmon to run this beck. An intensive biological survey planned for 1987 should determine whether this beck is affected by acidification which is one suggestion that has been put forward.

O+ TROUT

The mean density estimate of 11.85 O+ Trout/100m² for the Wenning catchment is far better than the Upper Middle, Lower Middle and Lower main River Lune groups of sites and also nearly twice as good as the Greta system (6.09/100m²). Apart from an excellent mean density estimate of 129.53/100m² on Chapel and Crosdale Becks, the remainder of the Lune catchment sites have mean density estimates of between 14.15 and 20.48 O+ Trout/100m². Taking the main river Wenning sites only, the mean density estimate of 6.89/100m² is much less than the Wenning catchment as a whole, but still slightly better than the Greta system. Some Wenning catchment sites have very good mean density estimates for O+ Trout however :- the two sites on Austwick Beck have 62.42/100m² and 66.51/100m², the river Roeburn at Winder Wood has 43.67/100m² and the three nursery stream sites surveyed in 1986 have very good O+ Trout density estimates with the site on Norber Syke particularly good with 190.17/100m². All sites on the Wenning catchment have had O+ Trout recorded at some time or other during the survey period although they have proved to be scarce or occasionally absent on the Wenning at Wennington and Hornby.

1++ TROUT

The mean density estimate of 6.03 1++ Trout/100m² for the Wenning catchment is bettered only by the estimates for Chapel and Crosdale Becks at 17.23/100m² and the Rawthey system at 6.19/100m². The mean density estimate of 5.06/100m² for the main river Wenning sites is still only bettered by these sites, although this mean is boosted by the results from the Greystonegill Bridge and the High and Low Bentham sites with very low estimates from Clapham Station (1.51/100m²), Wennington (1.17/100m²) and Hornby (1.71/100m²). The lack of

deeper water at the Clapham Station site gives a valid reason for the low density estimate, but this should not apply to the other two sites.

RATIO OF SALMON TO TROUT

Appendix 4 lists the ratio of Salmon to Trout for both 0+ and 1++ fish for each group of Lune catchment sites, calculated from the mean density estimates, and Appendix 5 lists the ratio for each Wenning catchment site, again calculated from mean density estimates.

0+ FISH

It is interesting to note that for 0+ fish, the only sites which have an estimated Trout density higher than the estimated salmon density are Chapel and Crosdale Becks and the Wenning catchment, i.e. the sites with the highest and lowest estimated 0+ Salmon densities respectively. (0+ Salmon/0+ Trout ratios of 0.47/1 and 0.45/1 respectively). Apart from the groups of sites on the Lower Middle and Lower Lune main river which are very much salmon dominated (ratios of 295.6/1 and 173.5/1 respectively for 0+ fish), all other groups of sites are in the range 1.01/1 to 5.48/1. The main river Wenning sites fall within this range with an estimated ratio of 1.37/1. Only four sites on the Wenning catchment have more 0+ Salmon than 0+ Trout (from mean density estimates) and at two of these sites, the Hindburn at Hindburn Bridge and the Wenning at Wennington, this is only due to heavy salmon fry planting in 1982. The other two sites are the Wenning at Clapham Station with a ratio of 1.68/1 and the Wenning at Hornby with a ratio of 104.07/1.

1++ FISH

Apart from the Rawthey system which has a Salmon to Trout ratio of just under 1/1 (0.95/1), the Wenning system is the only group of sites to have a higher ratio of 1++ Trout to 1++ Salmon (just over four times as many). The main river Wenning sites have just under three times as many 1++ Trout for every 1++ Salmon. Again the Lower Middle and Lower Lune main river sites give the highest Salmon to Trout ratios (90.5/1 and 15.0/1 respectively). All other sites are in the range 1.01/1 to 7.46/1. Of the Wenning catchment sites, four have had no 1++ Salmon recorded, and only one site, the Wenning at Hornby, has a higher Salmon to Trout ratio (3.23/1).

RATIO OF 0+ to 1++ FISH

Based on mean density estimates, Appendix 6 lists the ratio of 0+ to 1++ fish for both Salmon and Trout for each group of sites on the Lune catchment. Whilst not really a measure of recruitment success, it does give some indication of the proportion of salmon fry and parr at each group of sites. Appendix 7 lists the ratio for each Wenning catchment site.

SALMON

Apart from two groups of sites on the Lune, the Lower Middle and Lower Main river sites, which have 0+/1++ Salmon ratios of 8.17/1 and 30.84/1 respectively, all other groups of sites fall within a fairly close range - between 1.98/1 and 5.04/1. The Wenning system has a mean ratio of 3.86/1 and the main river Wenning sites a mean ratio of 5.04/1. The ratios at main river Wenning sites downstream of Greystonegill Bridge demonstrate the scarcity or absence of 0+ Salmon in this area. The only other site with a higher ratio of 1++ to 0+ salmon is on Clapham Beck, an area of natural spawning. This site would appear to show good recruitment to the 1++ stage. The ratio at

Clapham Station on the Wenning (35.42/1) demonstrates the 'shallow nursery-type' nature of the site. Apart from the sites mentioned and three sites where fry planting has given a misleading indication of the 'natural' 0+/1++ ratio, all other sites on the Wenning catchment are in the range 1.61/1 to 9.47/1.

TROUT

All groups of sites on the Lune catchment are within the range 1.36/1 to 7.52/1 for 0+/1++ Trout. The Wenning system is at the lower end of this range at 1.97/1 and the main river Wenning sites at the bottom of the range. For the Wenning catchment, the Wenning at Clapham Station and the two sites on Austwick Beck are highlighted as good nursery areas for 0+ Trout.

RIVER WENNING CATCHMENT. SITE BY SITE RESULTS AND COMMENTS

All results of electric fishing surveys undertaken on the Wenning catchment between 1981 and 86 are shown in Appendix 8.

WHARFE GILL SYKE, NR. AUSTWICK (SD 778 693)

This site was only surveyed in the summer of 1986 to assess success of ova planting. This is an area of heavy natural Sea Trout and Brown Trout spawning. In the Spring of 1986, 5,000 eyed salmon ova were introduced to this area. There has been survival to give an estimated density of 10.48 0+ Salmon/100m² which is better than the mean for the Wenning catchment but lower than most Lune catchment sites. There is likely to be competition with 0+ Trout which have an estimated population density of 52.44/100m², a high result compared with other Wenning (and Lune) catchment sites. The density estimate of 4.37 1++ Trout/100m² is fairly poor but probably a reflection of the limited deeper water in the stretch.

NORBER SYKE (WHITE BECK), D/S AUSTWICK ROAD (SD 775 692)

Again there is no natural salmon spawning at this site and 5,000 eyed salmon ova were introduced in this area in the Spring of 1986. The density estimate of 66.15 0+ Salmon/100m² represents good survival, particularly in view of the competition with Trout, whose population densities in the Summer of 1986 were estimated at 190.17/100m² for 0+ Trout and 16.54/100m² for 1+ Trout. These estimates compare closely with the best Lune catchment sites (Chapel and Crosdale Becks) in all but the 1++ Salmon population, and it will be interesting to see if good numbers of 1++ Salmon can be produced for this very productive beck.

AUSTWICK BECK AT HARDEN BRIDGE (SD 761 678)

This site is within an area of natural Salmon and Sea Trout spawning and is just upstream of the Austwick Scheme. Consequently it has not suffered any 'in-river' disruption. The 1982 result is for downstream of the bridge where the shallow riffle nature of the site gave very high numbers of 0+ Trout, (116.67/100m²). For the following three years, the site fished was upstream of the bridge where deeper water was available for older fish. In 1983, 0.28 0+ Salmon/100m² were estimated with 3.03 1++ Salmon/100m² estimated in 1984, indicating greater immigration than emigration at this site. This has obviously been the case again in 1985 with 1.21 1++ Salmon/100m² estimated after no 0+ Salmon were recorded in 1984. It is interesting to note that the very low density in 1983 and absence of 0+ Salmon in 1984 was during and just after the Austwick Scheme, and that in 1985 a good 0+ Salmon density of 28.28/100m² was estimated. Is it possible that this reflects disruption of natural spawning or movement of adult fish through the affected stretch and that now the Scheme is finished a more realistic density estimate is being shown? 1++ Salmon density estimates vary between 1.14 and 3.03 fish/100m², a mean of 1.79/100m², which is slightly better than the mean for the Wenning catchment. The 0+ Trout population also appears to be better in 1985 and at 114.34/100m², the estimate is very good. The lower density of 13.07 0+ Trout/100m² in 1983 may be due to the Austwick Scheme (depending on the proportion of Sea Trout in the population), whilst the 1984 density estimate of 72.12 fish/100m² is very good. This gives a mean estimate of 66.51 0+ Trout/100m², well above the mean for the catchment. The 1++ Trout mean density estimate of 4.99/100m² is lower than the mean for the Wenning catchment with a very poor result recorded in 1985.

AUSTWICK BECK AT WATERS FARM (SD 749 676)

This site in the middle of the Austwick Scheme was fished on two occasions, 1982 and 85 i.e. before and after the land drainage works. The population density estimates show a good improvement in 1985 for 0+ Salmon, 0+ Trout and 1++ Trout, with only 1++ Salmon showing a decline, which might be expected. The mean 0+ Salmon density estimate of 8.52/100m² is better than the mean for the Wenning catchment while the 1++ Salmon mean density estimate of 0.90/100m² is below the catchment average. Similarly, the mean 0+ density estimate of 62.42/100m² is better than the mean for the Wenning catchment with the 1++ Trout estimate of 2.22/100m² below the catchment mean.

FEN BECK AT WATERS BRIDGE (SD 754 668)

Heavy silt deposition from the Austwick Scheme has adversely affected this site and this has shown up in biological sampling. Electric fishing was carried out in 1982, 84 and 85. The survey in 1984 indicated the apparent absence of salmonids at the site but good recovery of 0+ Trout and to a lesser extent 1++ Trout was apparent in 1985. 1++ Salmon have never been recorded at this site and 0+ Salmon present in 1982 at an estimated density of 5.56/100m² have not been recorded since. Organic pollution problems on Fen Beck from the Lawkland area may also have accounted for poor results.

CLAPHAM BECK D/S A65 BRIDGE (SD 744 685)

This site is in a stretch where natural spawning of Sea Trout in particular and some Salmon takes place and is above any work done as part of the Austwick Scheme. From 1981 - 84, immigration of 1++ Salmon would appear to have exceeded emigration with 1++ Salmon density estimates greater than the 0+ Salmon density estimates for the preceding Summer. In 1984, 1.86 0+ Salmon/100m² were estimated with 1.30 1++ Salmon/100m² estimated the following summer. Assuming equal immigration/emigration, this would represent 70% survival. The mean density estimate of 1.16 0+ Salmon/100m² is below the mean for the Wenning catchment, but the mean density estimate of 3.72 1++ Salmon/100m² is better than the Wenning mean. These population estimates are fairly poor and possibly reflect competition from Trout (especially Sea Trout). The mean density estimate for 0+ Trout is 27.05/100m² which is well above the mean for the Wenning catchment, as is the mean estimate of 1++ Trout at 12.96/100m².

NUTTA BECK U/S CLAPHAM STATION (SD 726 688)

This site was only surveyed in 1986 to check for success of natural spawning. This is a good Sea Trout spawning beck but only two Salmon redds were counted in 1985 (both upstream of this site). No Salmon were recorded on the 1986 survey but a good 0+ Trout density of 35.92/100m² was estimated. The estimate of 8.70 1++ Trout/100m² is quite good given the limited deeper water at the site. Both of these population estimates are above the average for the Wenning catchment and all but the most productive of the Lune catchment sites.

KEASDEN BECK NEAR KEASDEN (SD 717 666)

Although there are no obstructions for migratory fish and this beck is at the upper end of the system, there appears to be no salmon spawning in Keasden Beck. Electrofishing surveys from 1982 - 85 have failed to record any Salmon, although Trout have been recorded on each occasion. There does appear to be a downward trend in the Trout population density estimates however, the 0+ estimate in 1982 was 25.00/100m² and in 1985 the estimate was only 2.80/100m². Similarly the 1++ Trout population estimate has declined from 15.83/100m² in 1982 to 1.60/100m² in 1985. Clearly this is a beck which warrants further investigation.

RIVER WENNING AT CLAPHAM STATION (SD 739 678)

This is a natural spawning area for Salmon and Sea Trout :- 17 Salmon redds and 10 Sea Trout redds were counted here in 1984, and 10 Salmon redds and 10 Sea Trout redds counted in 1985. The main spawning in the Wenning is in fact from this site upstream.

This site is very much a shallow riffly nursery area generally supporting a good stock of 0+ Salmonids but providing little cover for older fish. Survival estimates to the 1++ stage are therefore going to be very much an underestimation, with emigration probably far exceeding immigration :- the survival to 1++ Salmon has been calculated as varying from 1% to 11% since 1982, giving a mean survival of 5.4% for the site. It is interesting to note that the figure of 11% survival is for 1983 during the major works on the Austwick Scheme, not far upstream.

The mean population density estimates for both 1++ Salmon and 1++ Trout are low at 0.99/100m² and 1.51/100m² respectively. The mean density estimates for 0+ Salmon and 0+ Trout are very good at 35.07/100m² and 20.82/100m² respectively. For 0+ Salmon, the general range is estimated at between 3.68/100m² and 24.99/100m² although in 1985, 134.19/100m² was the density estimate. The 0+ Trout estimate for 1985 was also in fact the highest recorded for the site at 37.18/100m².

RIVER WENNING AT GREYSTONEGILL BRIDGE (SD 694 682)

This area has been extensively stocked with Salmon fry each year from 1982 - 85 and there has been no natural spawning in this area for at least two years. Being relatively near to the lower end of the natural salmonid spawning area (the site is approx. 4Km downstream of Clapham Station) one would expect some natural movement of parr and possibly fry to (and out) of the site.

No fry planting occurred at this site in 1981 and a 'natural' 0+ Salmon density of only 0.17/100m² was estimated in the Summer of 1981. The following Summer, a density of 2.22 1++ Salmon/100m² was estimated which obviously indicates immigration of parr to the site exceeding emigration. In April 1982, 80,000 unfed Salmon fry were introduced into the area (approx. 1 mile upstream and downstream of Greystonegill Bridge) and in the Summer of 1982, a density of 10.00/100m² was estimated for 0+ Salmon. The following year, a density of 5.13 1++ Salmon/100m² was estimated. If equal immigration/emigration is assumed, then survival to the 1++ Salmon stage is in the order of 51%.

In May 1983, 50,000 unfed Salmon fry were introduced into a similar stretch of the river and in the Summer, a density estimate of 5.86/100m² for 0+ Salmon was estimated and the following Summer a density of 2.09 1++ Salmon was estimated. Again if equal immigration/emigration is assumed, then survival to the 1++ Salmon stage is in the order of 36%.

In May 1984, 49,539 unfed Salmon fry were introduced upstream of Greystonegill Bridge. In the Summer of 1984, a density of 5.34 0+ Salmon/100m² was estimated and the following Summer a density of 1.65 1++ Salmon/100m² was estimated. Again assuming equal immigration/emigration, survival to the 1++ Salmon stage is in the order of 31%.

In May 1985, 20,000 unfed Salmon fry were introduced to the stretch of river upstream and downstream of Greystonegill Bridge. In the Summer of 1985, a density of 2.06 0+ Salmon/100m² was estimated and the following Summer a density of 4.91 1++ Salmon/100m² was estimated which would indicate more immigration of parr to the site than emigration.

No stocking of Salmon fry occurred at this site in 1986, yet a density of 2.80 O+ Salmon/100m² was estimated in the Summer survey. With no known natural spawning in the area it is likely that downstream displacement of fry to the site has occurred. It is interesting to note that this 'natural' salmon fry population density estimate is higher than the previous year when fry planting occurred.

When immigration of 1++ Salmon to the site is greater than emigration, then this is likely to indicate good 1++ Salmon production occurring upstream, there being a natural tendency for parr to move downstream. At this site, this situation appears to have occurred in 1981 and 86. This is before and well after the Austwick Scheme. During and just after the scheme, the estimate of survival from O+ to 1++ Salmon is between 31% and 51%. It is possible that 1++ Salmon production was reduced during this time but has now improved.

Despite the fairly heavy stocking of Salmon fry at this site, the mean density estimates for O+ and 1++ Salmon are poor at 4.37/100m² and 2.72/100m² respectively. Although this stretch would appear to be better 'parr territory' the 1++ Salmon estimates are low, although slightly better than the mean for the Wenning catchment. The mean O+ and 1++ Trout density estimates are fairly poor at 9.19/100m² and 7.10/100m² respectively which would seem to indicate that trout competition is not a limiting factor for salmon recruitment. The high abundance of Bullheads and Stoneloach is particularly noteworthy at this site however, and could be a significant factor. This warrants further investigation with possibly a look at stomach contents of these species at the site.

RIVER WENNING AT HIGH BENTHAM (SD 664 688)

The results from this site probably reflect the lack of Salmon spawning in this area, although there is some immigration of 1++ Salmon to the site, giving a mean density estimate of 2.54/100m². This is similar to the mean for the Greystonegill Bridge site and slightly better than the mean for the Wenning catchment. No 1++ Salmon were recorded on the last survey in 1985 however, and O+ Salmon have only been recorded on one occasion, 1982, at a low density estimate of 1.82/100m². The mean population density estimates for O+ and 1++ Trout are reasonable at 8.75/100m² and 14.77/100m² respectively.

RIVER WENNING AT LOW BENTHAM (SD 646 693)

Again the scarcity of Salmon in this section of river is shown in the results for this site with no O+ Salmon recorded on any of the surveys and very low numbers of 1++ Salmon recorded in 1983 and 84 only. (1.36/100m² and 0.42/100m² respectively). It would appear that there is little Salmonid spawning in this area with O+ Trout densities also very low (and absent in 1985), giving a mean density estimate of 1.78/100m². The mean density estimate for 1++ Trout is much better at 9.11/100m² although the estimate for 1985 is significantly reduced at only 1.39/100m² - water quality or dewatering effects from the fish farm upstream? Small numbers of Rainbow Trout (escapees from the fish farm) are often found at this site but have not been included in the Trout density estimates.

RIVER WENNING, THE BLANDS (SD 631 700)

This is another site away from the main Salmonid spawning areas and mainly supports only a small number of larger Trout. The mean density estimate for 1++ Trout is only 2.64/100m² and only small numbers of O+ Trout have been recorded each year to give a mean density estimate of 2.18/100m², both well below the mean for the Wenning catchment. O+ Salmon have not been recorded at this site and only a single 1++ Salmon has been recorded (1984) in the four surveys since 1982.

RIVER WENNING AT WENNINGTON (SD 614 702)

In April 1982, 80,000 unfed Salmon fry were introduced into the river Wenning mainly just upstream of this site. This is reflected in the results for the Summer 1982 survey when a density of 14.29 0+ Salmon/100m² was estimated. The following year a density of 1.00 1++ Salmon was estimated which represents only 7% survival. This is likely to be an underestimation however with emigration exceeding immigration. The following Summer (1984) a very low density of 0.44 1++ Salmon/100m² was estimated. Apart from the 1982 estimate, and a single 0+ Salmon recorded in 1984 (?), no 0+ Salmon were recorded on any other survey at this site. Competition with Trout is unlikely to have been a factor at this site as only extremely low densities have been recorded - mean density estimates of 0.55 0+ Trout/100m² and 1.17 1++ Trout/100m² from 1981-85 results. This clearly represents a 'pathologically low' Salmonid density for this site which probably warrants further investigation. The reasonable density estimate of 14.29 0+ Salmon/100m² in 1982 following fry planting does show that 0+ Salmon are capable of surviving in this area, although recruitment to the 1++ stage may not be so successful.

RIVER WENNING AT HORNBY (SD 582 684)

This site is not far downstream of an area of natural spawning (Hindburn foot) and consequently one might expect immigration of fry and parr to this site. In 1981 and 83 there were greater density estimates of 1++ Salmon than 0+ Salmon for the corresponding previous year. In 1985, assuming equal immigration/emigration, 49% survival to the 1++ Salmon stage has been estimated. In 1982 the high population density estimate of 43.57 0+ Salmon/100m² is undoubtedly a reflection of the fry planting in the Wenning upstream of Wennington and in the Hindburn at Wray earlier that year. The following year only 2.22 1++ Salmon/100m² were estimated which would give a figure of only 5% survival. This is likely to be an underestimate however. The mean density estimate of 0+ Salmon for this site is 13.53/100m², although if the high 1982 estimate is ignored, a more realistic mean density estimate would be 6.03/100m², which is slightly above the mean for the Wenning catchment. The mean density estimate for 1++ Salmon from 1981 - 85 is 5.52/100m² which is well above the mean for the Wenning catchment and similar to estimates for the Greta and Rawthey catchments. Surprisingly, the Trout population is very low with mean density estimates of only 0.13/100m² for 0+ Trout and 1.71/100m² for 1++ Trout, both well below the average for the Wenning catchment. At this site it would appear that Salmon do better than Trout, although it must be said that the 1++ Salmon numbers are still poor.

RIVER HINDBURN AT HELKS BANK (SD 652 639)

This site is upstream of an obstruction believed impassable to Salmon, although Sea Trout redds are counted here and further downstream. Not surprisingly no juvenile Salmon have been recorded at this site between 1981 - 85. The mean density estimates for 0+ and 1++ Trout are very similar at 20.96/100m² and 20.41/100m² respectively, both well above the mean for the Wenning catchment and better than all Lune catchment sites (apart from the most productive sites for 0+ Trout).

RIVER HINDBURN AT FURNESS FORD BRIDGE (SD 635 670)

Again this site is upstream of the obstruction believed impassable to Salmon but open to Sea Trout. The mean density estimates of 14.57/100m² for 0+ Trout and 12.51/100m² for 1++ Trout are reasonably good and above the mean for the Wenning catchment.

RIVER HINDBURN AT HINDBURN BRIDGE (SD 611 675)

There does not appear to be any natural spawning of Salmon in this area, although 1++ Salmon have been recorded on each survey since 1982. In April 1982, 40,000 unfed Salmon fry were introduced into the river Hindburn in the Wray area. In the Summer of 1982, good survival was evident with a density of 28.00 0+ Salmon/100m² estimated at Hindburn Bridge. The following Summer, a density of 4.75 1++ Salmon/100m² was estimated which would indicate 17% survival assuming equal immigration/emigration. There would appear to be natural immigration of 1++ Salmon to this site however, as although no 0+ Salmon were recorded in 1981, 1983 or 1984, 1++ Salmon densities of 2.00/100m², 3.13/100m² and 0.17/100m² (mean 1.77/100m²) were estimated in 1982, 1984 and 1985 respectively. If we therefore assume the 'natural' 1++ Salmon density at this site is 1.77/100m², then the survival to the 1++ Salmon stage from the 1982 0+ Salmon planting is in the order of 11%. The mean 1++ Salmon density estimate from 1981 - 1985 is 2.01/100m² which is slightly above the average for the Wenning catchment. The Trout density estimates at 3.80 0+ Trout/100m² and 4.61 1++ Trout/100m² are both below the average for the Wenning catchment.

RIVER ROEBURN, WINDER WOOD (SD 603 638)

Although there is no Salmon spawning here, there is limited Sea Trout and Brown Trout spawning in this area. Surveys prior to 1986 have not recorded any 0+ Salmon at this site although a single 1++ Salmon was recorded in 1983. In May 1986, this site was stocked with 27,000 fed Salmon fry and this was the first Salmon stocking here for at least 20 years. Reasonable survival was evident in the Summer of 1986 with a density of 12.43 0+ Salmon/100m² estimated. This density compares favourably with other Wenning catchment sites and is more than twice the average for the catchment (5.37/100m²). It will be interesting to see the success of recruitment to the 1++ Salmon stage particularly in view of the reasonable Trout population at the site (1981 - 86 mean density estimates of 43.67/100m² and 15.94/100m² for 0+ and 1++ Trout respectively). These Trout density estimates are well above the average for the Wenning catchment and are better than all but the most productive Lune catchment sites. If recruitment to 1++ Salmon in 1987 is successful then this could have implications for considering salmon stockings in rivers with reasonable Trout populations. The Salmon fry stocking in 1986 does not appear to have had a significant effect on Trout densities which would suggest the natural salmonid density is not at full capacity.

RIVER ROEBURN AT WRAY (SD 604 672)

Again no natural salmon spawning occurs in this area. The high 0+ Salmon density estimate of 27.92/100m² in 1982 is undoubtedly a reflection of fry planting in the Hindburn at Wray earlier that year. The following year, 7.71 1++ Salmon/100m² were estimated which represents 28% survival assuming equal immigration/emigration. In 1981 and 83 a small number of 'natural salmon fry' were recorded, with greater density estimates of 1++ Salmon in the corresponding following years, indicating greater immigration than emigration. No 'natural' 0+ Salmon were recorded in 1984 and no 1++ Salmon the following year, although a density of 4.00 0+ Salmon/100m² was estimated in 1985. The mean density estimate of 3.50 1++ Salmon/100m² is fairly poor but better than the mean for the Wenning catchment. The Trout population density estimates of 15.48/100m² and 7.14/100m² for 0+ and 1++ Trout respectively are better than the means for the Wenning catchment.

CONCLUSIONS

The mean density estimate for Total 0+ Salmonids for the Wenning catchment is 17.22/100m² which can be regarded as 'Poor' and is lower than the mean estimates for most of the Lune catchment sites. The mean density estimate for Total 1++ Salmonids is 7.42/100m² for the Wenning catchment which can be regarded as 'Bad' and again is lower than most Lune catchment sites. In terms of 0+ Salmon, the Wenning catchment mean density estimate of 5.37/100m² is the lowest for any of the Lune catchment sites with the mean main river Wenning density estimate slightly better at 9.43/100m² but still lower than most Lune catchment sites. The mean density estimate for 1++ Salmon for the Wenning catchment is 1.39/100m² which is lower than the mean density estimates of all Lune catchment sites except the lower main river Lune group of sites. In terms of estimated Trout densities, the Wenning catchment is better than many of the Lune catchment sites. The mean 0+ Trout density estimate for the Wenning catchment is 11.85/100m² which is better than most main river Lune sites and better than the Greta system. The mean 1++ Trout density estimate for the Wenning catchment is 6.03/100m² which is bettered only by the mean density estimates for Chapel and Crosdale Becks (17.23/100m²) and the Rawthey system (6.19/100m²).

In terms of ratio of Salmon to Trout, for 0+ fish the only sites which have an estimated Trout density higher than the estimated Salmon density are Chapel and Crosdale Becks and the Wenning catchment, i.e. the groups of sites with the highest and lowest 0+ Salmon density estimates respectively. Apart from the Rawthey system, the Wenning catchment is the only group of sites to have a higher estimated 1++ trout density than the estimated 1++ Salmon density. The ratio of 0+ to 1++ Salmon for the Wenning catchment appears to fall within the 'typical' range for the Lune catchment.

The general scarcity of Salmonids in large sections of the main river Wenning probably reflects the lack of natural Salmon and Sea Trout spawning in these areas, and the fairly low resident Brown Trout densities in these areas is probably also a reflection of limited spawning success. The lack of natural spawning is probably a reflection of physical conditions in the river, i.e. lack of suitable gravelly areas, but this is something which should be investigated further. If lack of suitable substratum is indeed a major limiting factor then the feasibility of creating suitable spawning areas, i.e. transporting suitable gravel to a site and ensuring it does not get washed out, perhaps ought to be considered. At some sites, e.g. the river Wenning at Wennington, one might describe the salmonid population as being 'pathologically low'. One of the main concerns about the Wenning catchment is the apparent poor recruitment of salmon to the parr (1++) stage. With only limited natural spawning at the top end of the Wenning and even more limited salmon spawning at Hindburn foot, distribution of 1++ Salmon is going to be fairly sporadic between Greystonegill and Hornby (although there is a natural tendency for downstream dispersion) and this is reflected in the results with particularly low density estimates or absence of 1++ Salmonids regularly at Low Bentham, The Blands and Wennington in particular.

Whilst some apparent success of recruitment to the 1++ salmon stage has occurred from regular heavy salmon fry planting at the Greystonegill Bridge area, low 1++ Salmon densities are still estimated and it is interesting to note that in 1986 with no fry planting in the area, a higher 0+ Salmon density was estimated than in the previous year when fry planting took place. Obviously justification for future heavy fry planting of main river sites will have to be looked at closely. From the 1986 survey work, the small nursery stream sites looked at in the Austwick area, particularly Norber Syke, have shown good survival of 0+ Salmon from ova planting, even with the presence of very good Trout densities, and fry planting in the River Roeburn at Winder Wood has shown good survival of 0+ Salmon again in the

presence of good Trout densities. Whether these sites will show good recruitment to the 1++ stage is something which ought to be monitored next summer. Previous fry planting appears to have been reasonably successful in 1982 in the river Hindburn at Wray with additional benefits to the Lower Roeburn with apparent reasonable survival to the 1++ stage, but heavy planting that year in the Wenning above Wennington whilst giving good 0+ Salmon density estimates does not appear to have resulted in good survival to the 1++ stage.

Looking at the Salmon density estimates for the main river Wenning sites between 1981 and 1986, it does not appear that the Austwick Scheme has directly affected the numbers with, at some sites, better 1++ density estimates during the scheme than before or after. Biological sampling indicated little or no effect on the main river. Water quality does not appear to be responsible for the very low Salmonid densities at some main river sites but further sampling and investigation is desirable particularly in the Wennington area. The apparent lack of Salmon in Keasden Beck also warrants further investigation.

FUTURE WORK RECOMMENDATIONS

Increased biological monitoring of the Wenning catchment, particularly from High Bentham to Wennington, and Keasden Beck.

Follow up 1986 ova and fry planting by electrofishing to look for success of recruitment to 1++ stage.

Further electrofishing surveys of lower main river Wenning where 'pathologically low' Salmonid densities appear to exist.

Investigate possible competition/predation by Stoneloach and Bullheads particularly at sites like Greystonegill Bridge.

Look at types of substratum in those stretches of river where no natural spawning takes place.

APPENDIX 1

SUMMARY OF RIVER LUNE CATCHMENT ELECTRIC FISHING, 1981 - 85. (MEAN NO. FISH/100m²)

<u>Group of Sites</u>	<u>SALMON</u>		<u>TROUT</u>		<u>TOTAL SALMONIDS</u>	
	0+	1++	0+	1++	0+	1++
RIVER LUNE & TRIBUTARIES U/S TEBAY	39.90	8.20	18.86	4.65	58.76	12.85
UPPER MIDDLE LUNE (LOW BORROW BR. - BROADRAINE)	10.02	4.55	1.83	0.61	11.85	5.16
LOWER MIDDLE LUNE (KILLINGTON - K. LONSDALE)	14.78	1.81	0.05	0.02	14.83	1.83
LOWER LUNE (WHITTINGTON - CATON)	13.88	0.45	0.08	0.03	13.96	0.48
BIRK BECK & BORROW BECK	20.78	10.52	20.48	3.97	41.26	14.49
MINOR UPPER-MID LUNE TRIBS. (CHAPEL & CROSDALE BECKS)	60.85	17.40	129.53	17.23	190.38	34.63
RAWTHEY SYSTEM (INCL. CLOUGH & DEE)	19.80	5.88	15.65	6.19	35.45	12.07
MINOR MID-LUNE TRIBS. (BARBON & LECK BECKS)	50.86	12.24	14.15	4.96	65.01	17.20
GRETA SYSTEM	12.20	5.88	6.09	3.53	18.29	9.41
WENNING SYSTEM (INCL. ROEBURN & HINDBURN)	5.37	1.39	11.85	6.03	17.22	7.42
MAIN RIVER WENNING (HORNBY - CLAPHAM STATION)	9.43	1.87	6.89	5.06	16.32	6.93

N.B. Trout data is from 1981 - 84.

APPENDIX 2

RANKING OF RIVER WENNING CATCHMENT SITES
BASED ON MEAN TOTAL 1++ SALMONID DENSITY ESTIMATES, 1981 - 85.

<u>SITE</u>	<u>1++ SALMONIDS/100m²</u>
RIVER HINDBURN at Helks Bank	20.41
RIVER WENNING at High Bentham	17.31
CLAPHAM BECK d/s A65 Bridge	16.68
RIVER ROEBURN, Winder Wood	16.04
RIVER HINDBURN, Furness Ford Bridge	12.51
RIVER ROEBURN at Wray	10.64
RIVER WENNING, Greystonegill Bridge	9.82
RIVER WENNING at Low Bentham	9.56
KEASDEN BECK, Near Keasden	8.55
RIVER WENNING at Hornby	7.23
AUSTWICK BECK, Harden Bridge	6.78
RIVER HINDBURN, Hindburn Bridge	6.62
FEN BECK, Waters Bridge	3.97
AUSTWICK BECK, Waters Farm	3.12
RIVER WENNING, The Blands	2.69
RIVER WENNING, Clapham Station	2.50
RIVER WENNING at Wennington	1.46

APPENDIX 3

RANKING OF RIVER WENNING CATCHMENT SITES
BASED ON MEAN 1++ SALMON DENSITY ESTIMATES, 1981 - 85.

<u>SITE</u>	<u>1++ SALMON/100m²</u>
RIVER WENNING at Hornby	5.52
CLAPHAM BECK, d/s A65 Bridge	3.72
RIVER ROEBURN at Wray	3.50
RIVER WENNING, Greystonegill Bridge	2.72
RIVER WENNING at High Bentham	2.54
RIVER HINDBURN, Hindburn Bridge	2.01
AUSTWICK BECK, Harden Bridge	1.79
RIVER WENNING, Clapham Station	0.99
AUSTWICK BECK, Waters Farm	0.90
RIVER WENNING at Low Bentham	0.45
RIVER WENNING at Wennington	0.29
RIVER ROEBURN, Winder Wood	0.10
RIVER WENNING, The Blands	0.05
RIVER HINDBURN, Furness Ford Bridge	0
RIVER HINDBURN, Helks Bank	0
KEASDEN BECK, Near Keasden	0
FEN BECK, Waters Bridge	0

APPENDIX 4

RIVER LUNE CATCHMENT ELECTRIC FISHING RESULTS 1981 - 85.
RATIO OF SALMON : TROUT/100m²

	<u>0+</u>	<u>1++</u>
RIVER LUNE & TRIBS., U/S TEBAY	2.16/1	1.76/1
UPPER MIDDLE LUNE (LOW BORROW BR. - BROADRAINE)	5.48/1	7.46/1
LOWER MIDDLE LUNE (KILLINGTON - K. LONSDALE)	295.60/1	90.50/1
LOWER LUNE (WHITTINGTON - CATON)	173.50/1	15.00/1
BIRK BECK & BORROW BECK	1.01/1	2.65/1
MINOR UPPER-MID LUNE TRIBS. (CHAPEL & CROSDALE BECKS)	0.47/1	1.01/1
RAWTHEY SYSTEM (INCL. CLOUGH & DEE)	1.27/1	0.95/1
MINOR MID LUNE TRIBS. (BARBON & LECK BECKS)	3.59/1	2.47/1
GRETA SYSTEM	2.00/1	1.67/1
WENNING SYSTEM (INCL. ROEBURN & HINDBURN)	0.45/1	0.23/1
MAIN RIVER WENNING (HORNBY - CLAPHAM STATION)	1.37/1	0.37/1

APPENDIX 5

COMPARISONS OF SALMON & TROUT ABUNDANCES AT RIVER WENNING CATCHMENT SITES 1981 - 86

	<u>Ratio of</u> <u>0+ Salmon to</u> <u>0+ Trout/100m²</u>	<u>Ratio of</u> <u>1++ Salmon to</u> <u>1++ Trout/100m²</u>
AUSTWICK BECK, Harden Bridge	0.14/1	0.36/1
AUSTWICK BECK, Waters Farm	0.14/1	0.41/1
FEN BECK, Waters Bridge	0.12/1	All Trout
CLAPHAM BECK, d/s A65 Bridge	0.04/1	0.29/1
KEASDEN BECK, Near Keasden	All Trout	All Trout
RIVER WENNING, Clapham Station	1.68/1	0.66/1
RIVER WENNING, Greystonegill Bridge	0.48/1	0.38/1
RIVER WENNING at High Bentham	0.05/1	0.17/1
RIVER WENNING at Low Bentham	All Trout	0.05/1
RIVER WENNING, The Blands	All Trout	0.02/1
RIVER WENNING at Wennington	5.25/1	0.25/1
RIVER WENNING at Hornby	104.07/1	3.23/1
RIVER HINDBURN, Helks Bank	All Trout	All Trout
RIVER HINDBURN, Furness Ford Bridge	All Trout	All Trout
RIVER HINDBURN, Hindburn Bridge	1.48/1	0.44/1
RIVER ROEBURN, Winder Wood	0.05/1	0.01/1
RIVER ROEBURN at Wray	0.44/1	0.49/1

APPENDIX 6

RIVER LUNE CATCHMENT ELECTRIC FISHING RESULTS 1981 - 85
RATIO OF 0+ TO 1++ FISH/100m²

	<u>SALMON</u>	<u>TROUT</u>
RIVER LUNE & TRIBS., U/S TEBAY	4.87/1	4.06/1
UPPER MIDDLE LUNE (LOW BORROW BR. - BROADRAINE)	2.20/1	3.00/1
LOWER MIDDLE LUNE (KILLINGTON - K. LONSDALE)	8.17/1	2.50/1
LOWER LUNE (WHITTINGTON - CATON)	30.84/1	2.67/1
BIRK BECK & BORROW BECK	1.98/1	5.16/1
MINOR UPPER-MID LUNE TRIBS. (CHAPEL & CROSDALE BECKS)	3.50/1	7.52/1
RAWTHEY SYSTEM (INCL. CLOUGH & DEE)	3.37/1	2.53/1
MINOR MID LUNE TRIBS. (BARBON & LECK BECKS)	4.16/1	2.85/1
GRETA SYSTEM	2.07/1	1.73/1
WENNING SYSTEM (INCL. ROEBURN & HINDBURN)	3.86/1	1.97/1
MAIN RIVER WENNING (HORNBY - CLAPHAM STATION)	5.04/1	1.36/1

APPENDIX 7

RIVER WENNING CATCHMENT SITES, 1981 - 86.
RATIO OF 0+ TO 1++ FISH/100m²

	<u>SALMON</u>	<u>TROUT</u>
AUSTWICK BECK, Harden Bridge	5.32/1	13.33/1
AUSTWICK BECK, Waters Farm	9.47/1	28.12/1
FEN BECK, Waters Bridge	All 0+ Salmon	3.73/1
CLAPHAM BECK, d/s A65 Bridge	0.31/1	2.09/1
KEASDEN BECK, Near Keasden	All Trout	1.35/1
RIVER WENNING, Clapham Station	35.42/1	13.79/1
RIVER WENNING, Greystonegill Bridge	1.61/1	1.29/1
RIVER WENNING at High Bentham	0.18/1	0.59/1
RIVER WENNING at Low Bentham	All 1++ Salmon	0.20/1
RIVER WENNING, The Blands	All 1++ Salmon	0.83/1
RIVER WENNING at Wennington	9.97/1 *	0.47/1
RIVER WENNING at Hornby	2.45/1	0.08/1
RIVER HINDBURN, Helks Bank	All Trout	1.03/1
RIVER HINDBURN, Furness Ford Bridge	All Trout	1.16/1
RIVER HINDBURN, Hindburn Bridge	2.80/1 *	0.82/1
RIVER ROEBURN, Winder Wood	20.7/1 **	2.74/1
RIVER ROEBURN at Wray	1.95/1	2.17/1

* Effect of salmon fry planting in 1982

** Effect of salmon fry planting 1986

APPENDIX 8

R.WENNING CATCHMENT, ELECTRO-FISHING RESULTS 1981-86

(NO/100m²)

SALMON	TROUT
0+ 1++	0+ 1++

AUSTWICK BECK

HARDEN BRIDGE SD 761 678

1981				
1982	(6.35)	(0)	(116.67)	(6.35)
1983	0.28	1.14	13.07	5.68
1984	0	3.03	72.12	8.48
1985	28.28	1.21	114.34	0.81
1986				
MEAN	8.73	1.35	79.05	5.33

AUSTWICK BECK

WATERS FARM SD749 676

1981				
1982	2.42	1.21	24.24	1.52
1983				
1984				
1985	14.62	0.58	100.60	2.92
1986				
MEAN	8.52	0.90	62.42	2.22

FEN BECK

WATERS BRIDGE SD 754 668

1981				
1982	5.56	0	19.44	8.33
1983				
1984	0	0	0	0
1985	0	0	25.0	3.57
1986				
MEAN	1.85	0	14.81	3.97

CLAPHAM BECK

d/s A65 BRIDGE SD 744 685

1981	1.00	3.51	5.01	7.02
1982	1.83	5.86	22.34	12.09
1983	1.09	3.27	16.36	12.36
1984	1.86	4.65	65.58	19.53
1985	0	1.30	25.97	13.80
1986				
MEAN	1.16	3.72	27.05	12.96

KEASDEN BECK
NR KEASDEN SD 717 666

	(NO/100m ²)			
	SALMON		TROUT	
	0+	1++	0+	1++
1981				
1982	0	0	25.00	15.83
1983	0	0	16.00	8.00
1984	0	0	2.50	8.75
1985	0	0	2.80	1.60
1986				
MEAN	0	0	11.58	8.55

RIVER WENNING
CLAPHAM STATION SD 739 678

1981	3.68	0.97	5.62	3.10
1982	24.49	0.21	6.62	1.71
1983	15.22	2.78	26.51	0.65
1984	9.51	0.56	20.70	0.28
1985	134.19	0.43	37.18	0.43
1986	23.34	0.96	28.31	2.86
MEAN	35.07	0.99	20.82	1.51

RIVER WENNING
GREYSTONEGILL BRIDGE SD 694 682

1981	0.17	0.34	1.35	3.37
1982	10.00	2.22	12.50	14.44
1983	5.86	5.13	8.42	7.33
1984	5.35	2.09	11.40	2.09
1985	2.06	1.65	14.81	4.16
1986	2.80	4.91	6.67	11.23
MEAN	4.37	2.72	9.19	7.10

RIVER WENNING
HIGH BENTHAM SD 664 688

1981				
1982	1.82	1.82	9.09	21.36
1983	0	7.31	21.05	17.84
1984	0	1.04	0	15.63
1985	0	0	4.85	4.24
1986				
MEAN	0.46	2.54	8.75	14.77

RIVER WENNING
LOW BENTHAM SD646 693

	(NO/100m ²)			
	SALMON		TROUT	
	0+	1++	0+	1++
1981				
1982	0	0	2.61	14.78
1983	0	1.36	4.08	9.86
1984	0	0.42	0.42	10.42
1985	0	0	0	1.39
1986				
MEAN	0	0.45	1.78	9.11

RIVER WENNING
THE BLANDS SD631 700

1981				
1982	0	0	0.89	4.00
1983	0	0	7.23	2.93
1984	0	0.18	0.18	3.21
1985	0	0	0.43	0.43
1986				
MEAN	0	0.05	2.18	2.64

RIVER WENNING
WENNINGTON SD 614 702

1981	0	0	0	0.68
1982	14.29	0	0	0.44
1983	0	1.00	1.88	1.50
1984	0.15	0.44	0	1.62
1985	0	0	0.88	1.59
1986				
MEAN	2.89	0.29	0.55	1.17

RIVER WENNING
HORNBY SD582 684

1981	2.71	0.83	0.21	0.63
1982	43.57	10.00	0	1.43
1983	7.92	2.22	0.28	2.36
1984	6.07	11.61	0.18	2.32
1985	7.40	2.96	0	1.81
1986				
MEAN	13.53	5.52	0.13	1.71

RIVER HINDBURN
HELKS BANK SD652 632

	(NO/100m ²)			
	SALMON		TROUT	
	0+	1++	0+	1++
1981	0	0	2.04	14.27
1982	0	0	49.21	16.67
1983	0	0	36.17	17.02
1984	0	0	6.67	35.00
1985	0	0	10.70	19.07
1986				
MEAN	0	0	20.96	20.41

RIVER HINDBURN
FURNESS FORD BR SD635 670

1981	0	0	6.55	5.64
1982	0	0	19.05	22.38
1983	0	0	33.33	10.28
1984	0	0	1.60	14.80
1985	0	0	12.32	9.46
1986				
MEAN	0	0	14.57	12.51

RIVER HINDBURN
HINDBURN BRIDGE SD611 675

1981	0	0	2.80	6.00
1982	28.00	2.00	2.50	4.50
1983	0	4.75	10.50	3.00
1984	0	3.13	1.39	9.03
1985	0.17	0.17	1.83	0.50
1986				
MEAN	5.63	2.01	3.80	4.61

RIVER ROEBURN
WINDER WOOD SD603 638

1981	0	0	14.69	8.55
1982	0	0	80.00	34.17
1983	0	0.59	62.35	14.71
1984	0	0	5.00	18.13
1985	0	0	57.62	7.62
1986	12.43	0	42.37	12.43
MEAN	2.07	0.10	43.67	15.94

RIVER ROEBURN
WRAY SD604 672

	(NO/100m ²)			
	SALMON		TROUT	
	0+	1++	0+	1++
1981	0.75	0.50	6.25	4.25
1982	27.92	7.08	30.00	12.50
1983	1.43	7.71	29.14	4.86
1984	0	2.20	3.31	10.19
1985	4.00	0	8.71	3.88
1986				
MEAN	6.82	3.50	15.48	7.14

WHARFE GILL SYKE
NR.AUSTWICK SD778 693

1981				
1982				
1983				
1984				
1985				
1986	10.48	0	52.44	4.37
MEAN				

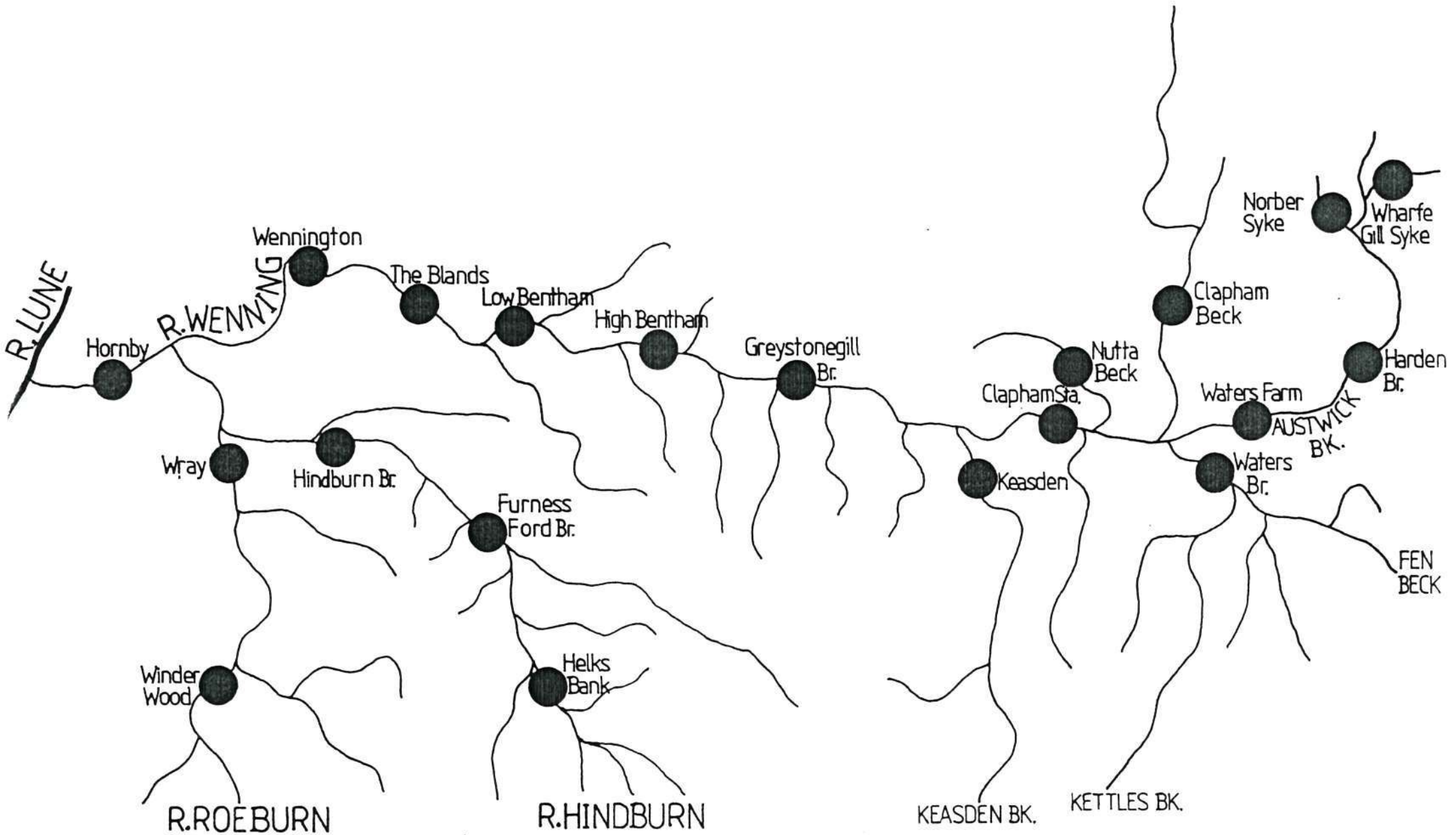
NORBER SYKE
D/S AUSTWICK RD. SD775 692

1981				
1982				
1983				
1984				
1985				
1986	66.15	0	190.17	16.54
MEAN				

NUTTA BECK
U/S CLAPHAM STATION SD726 688

1981				
1982				
1983				
1984				
1985				
1986	0	0	35.92	8.70
MEAN				

RIVER WENNING CATCHMENT ELECTRIC FISHING SURVEY SITES 1981-86



RIVER WENNING CATCHMENT
AREAS OF NATURAL SPAWNING 1984

SALMON 
SEA TROUT 

