

**A REPORT ON THE 1992 STRATEGIC STOCK ASSESSMENT SURVEY
OF THE UPPER EDEN CATCHMENT
WITH PARTICULAR REFERENCE TO SALMONIDS**

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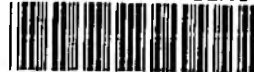
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ENVIRONMENT AGENCY



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SUMMARY

Sixty-nine sites in the Upper Eden catchment were electrofished in 1992 to assess juvenile salmon and trout (salmonid) populations. The survey was targeted at fish normally less than 2 years old by selecting sites with a shallow riffle pool structure. The deeper (>1m) waters associated with larger trout were not surveyed so it is essential to interpret the results for older brown trout with caution.

The densities found of each age class of salmon and trout are presented on maps as abundance classes. Total salmonid density indices are also presented.

Salmonid fish were found at all sites.

At 39 sites (56%) the Total Salmonid Density Index was Class C or better representing a healthy situation for these sites.

However at 30 sites (43%) the Total Salmonid Density Index was Class D, ie. poor. For 15 of these the low densities can be attributed to poor physical habitat, low summer flows and difficulties sampling large rivers. At the remaining 15 there is concern about low numbers, especially on the Leith and Lyvennet system.

The highest salmonid densities were found on the Pennine streams from Crowdundle Beck to Hilton Beck and also on Scandal Beck.

Salmon fry were widespread; most tributaries had sites with both high and low densities. However, poor densities were found on the Leith and Lyvennet system despite 67,000 being stocked in 1992.

Salmon parr were less widespread than fry although more sites supported the higher density classes.

Trout fry densities were generally low, although higher densities were present, principally in the upper reaches of streams such as Lyvennet and those flowing from the Pennines.

Older trout densities were generally good, especially in the upper reaches of many streams. However, older trout were absent, or at low densities at several sites. Those of concern being on the River Leith and some on the Lyvennet and Helm Beck.

Eel, stone loach, bullhead and minnows were widespread and abundant at many sites. Stickleback and lamprey were less common.

Major coarse fish such as dace and chub were not found at the survey sites and in general this is what would be expected, given the nature of the areas surveyed.

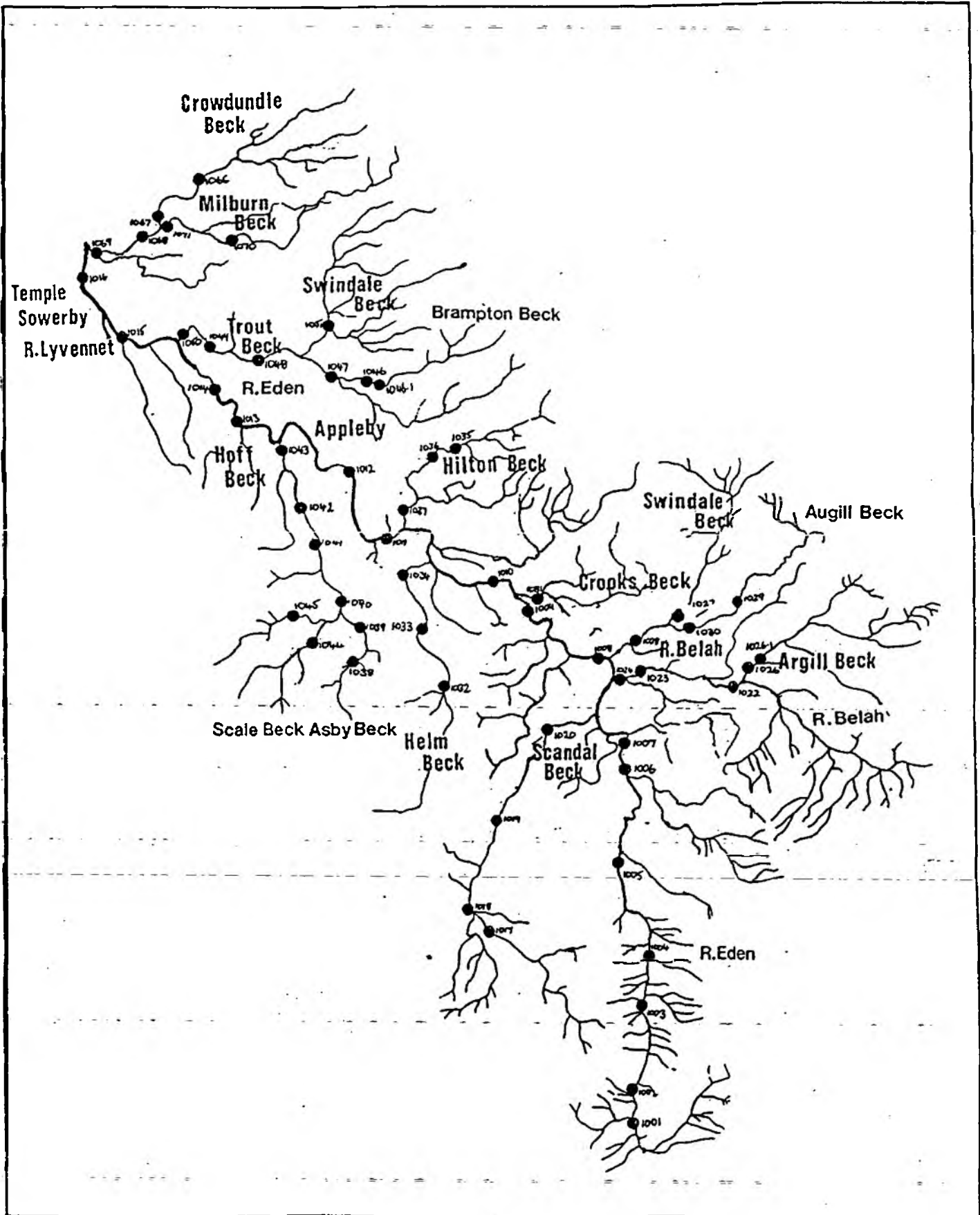
Recommendations for further work are presented for streams or reaches on streams where populations gave cause for concern. This includes summaries of work already undertaken.

ACKNOWLEDGEMENTS

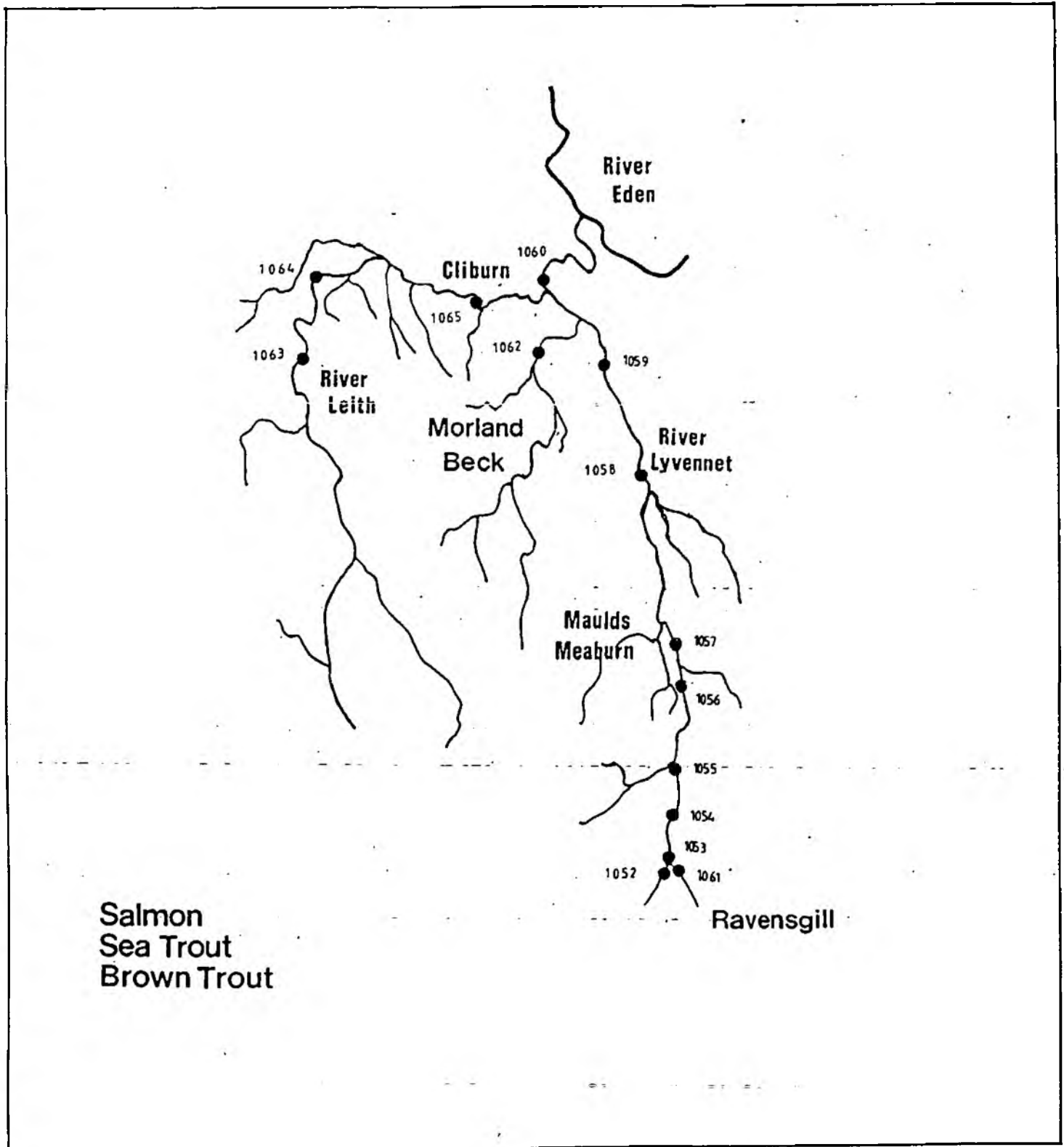
The work for this report was by no means a one person effort and there are several people to thank. In particular I thank the Eden District Bailiff team who despite such a significant change in their work approached the surveys willingly and professionally. I would like to thank Steve Douglas for his support and for comments on my draft. I also thank Amanda Cruddas, Helen Ashburner and Julian Parkin and Roy, my husband. Gill Watson deserves a special thank you for typing this report and tolerating my frequent amendments so patiently.

UPPER EDEN CATCHMENT

FIGURE A



LEITH, LYVENNET CATCHMENT



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INTRODUCTION

Under the Water Resources Act, 1991, the N.R.A. has a responsibility to maintain, improve and develop fisheries. In order to help accomplish this the N.R.A. is collecting baseline data on fish populations. A strategic survey programme has been established with the primary aim of assessing juvenile salmonid populations using electrofishing methods. Salmonid fish include salmon (*Salmo salar*) and both the migratory and residential forms of the trout (*Salmo trutta*). The survey was targeted at young salmonids (normally less than 2 years old) by selecting sites with a riffle/pool structure. The deeper waters associated with larger trout were not surveyed as available methods are not effective. Consequently results for older trout populations should be interpreted with caution.

Strategic surveys are being conducted throughout the N.R.A. and surveys have been conducted concurrently throughout Cumbria. The strategic survey is designed to be a rolling programme initially surveying new catchments or parts of catchments each year. It is expected to take 8 years to complete the cycle on the Eden and Border Esk due to the large size of their catchments.

For the purposes of this survey the Upper Eden was defined as the area of catchment from Crowdundle Beck which flows in the Eden a short distance downstream of the A66 near Temple Sowerby. The survey area is shown on two maps, Figures A and B.

METHODS

Sixty nine sites were surveyed as part of the Strategic Survey in 1992. The sites encompassed the catchment from near the source at Hanging Lund to Temple Sowerby. Crowdundle Beck catchment was included as was the Lyvennet system.

Sites were selected at approximately 1km intervals where access was suitable, these were approximately 50m long. Where possible, sites were selected to target juvenile Salmonid populations.

The sites were electrofished once through without stopnets. From the raw data densities were calculated (see Appendix 1 for calculations) and expressed as "number of fish per 100m² of wetted area". All sites were then assigned to Abundance Classes (Table 1).

Table 1 Abundance Classes

Density of salmonid expressed as numbers 100m⁻²

<u>Abundance Class</u>		<u>Age class</u>	
		<u>0+ (fry)</u>	<u>>0+ (parr and older)</u>
A		> 100	>20
B		50.01 - 100	10.01 - 20.00
C		25.01 - 50.00	5.01 - 10.00
D+		20.01 - 25.00	-
D		10.01 - 20.00	0.01 - 5.00
D -		0.01 - 10.00	-
E		0	0

The 0+ (fry) density classes are broad, especially Class D which includes sites with extremely low populations at the lower end and reasonable numbers at the top end of the range. For this reason Class D has been split as shown in Table 1. Class A for 0+ fish represents sites with exceptional densities.

Abundance class maps were produced for salmon 0+ (fry), salmon >0+, trout 0+ (fry), trout >0+ and total salmonids (Figs 1-5). The Lyvennet system is shown on separate maps (Figs 11-15).

Maps of stocking location, redd counts and obstacles to migratory fish are also included (Figs 6-10 and 16-19). Note that in 1992 fry stocked in 1991 would be parr, and that 1990 and 1991 redds would result in parr and fry respectively in 1992.

Coarse fish were also recorded. Eels were counted and measured and minor coarse fish, eg. stone loach and minnows, were recorded according to the following abundance classes; 0, 1-10, 11-100, 101-1000, 1000+.

RESULTS

The full range of abundance classes was present for each species of salmonid and age class.

The breakdown of the number of sites in each density class is shown in Table 2.

Table 2 - Number of sites in each Density Class for each species of salmonid and age category

<u>Density Class</u>	<u>Salmon 0+</u>	<u>Salmon >0+</u>	<u>Trout 0+</u>	<u>Trout >0+</u>	<u>Total Salmonid Index</u>
A	3	8	1	7	10
B	5	7	10	9	15
C	10	6	4	18	14
D+	6		2		
D	12	20	11	24	30
D-	18		37		
E	15	2	4	11	0

The larger main River Eden sites mainly yielded low densities of fish. This is not unusual for two main reasons:

1. The habitat of large main rivers is often unsuitable for juvenile salmonids and would normally be expected to support only low densities and
2. The wide, deep and often fast nature of the sites makes it difficult to catch the fish that are present.

SALMON

Salmon 0+ (Figs 1 and 11)

Most of the tributaries of the Upper Eden had sites which supported high (Classes C and above) densities of salmon fry, this was also true of some sites on the main river. These areas were:

The River Belah catchment
Augill Beck
The lower reaches of Scandal Beck
Hilton Beck
Hoff Beck (middle reach)

The Trout Beck catchment
The Crowdundle Beck system
The Lyvennet and Leith at individual sites (stocked).
The River Eden from Hanging Lund to Outhgill (stocked) and
The River Eden at Sandford and Brockam

Most of these streams also had sites with low (Class D) densities.

Sites with exceptional densities of over 100 fry per 100m² (Class A) were found on :

Argill Beck
The River Belah and
The River Eden at Hanging Lund. The high numbers on Argill Beck and
the Belah were due to natural productivity.

Salmon fry were recorded at all but 15 sites. Five of which are located upstream of waterfalls, 6 upstream of the weir at Maulds Meaburn and 1 upstream of a road culvert. The weir at Maulds Meaburn is rarely passable to migratory fish. On Helm and Scandal Beck fry were absent from the farthest upstream sites where salmon redds have not been recorded. Crooks Beck does support salmon fry but they were not recorded at the survey site due to lack of suitable habitat.

Upstream of Stenkrith falls, near Kirkby Stephen, salmon would normally be absent but this reach was stocked by the N.R.A. in Spring 1992.

Survey sites stocked with fry in 1992 appear to have low, Class D, densities except for the two uppermost sites on the main River Eden. The Leith and Lyvennet system was stocked with 67,000 salmon fry in 1992 and only 2 of the 14 sites have densities higher than Class D. This poor survival in what was historically a productive salmon catchment indicates that there is a problem.

Salmon >0+ (parr) (Figs 2 and 12)

Abundant salmon parr were found in the streams flowing from the Pennines to the north and east of Appleby namely:

Hilton Beck
The Trout Beck System and
The Crowdundle Beck system

High densities were also found on:

Scandal Beck and
The River Belah system.

Only low densities of parr were found at all the main river Eden sites and also at most sites on Hoff Beck and Helm Beck.

Salmon parr were not recorded at 28 sites in the Upper Eden, ie more sites appeared to lack salmon parr than fry. This included 5 sites on the River Eden upstream of the impassable falls at Stenkrith where salmon would not be expected.

The Swindale Beck system at Brough did not yield any salmon parr during the surveys.

Salmon parr were recorded at only 3 of the 14 sites on the Lyvennet system. These sites were not stocked in 1991 (Fig 16), apart from Morland Beck, and the results show that the system currently doesn't support many juvenile salmon indicating that there is a problem in the Leith and Lyvennet catchments.

Many of the sites with high salmon parr densities were stocked in 1991 (Figs 6 and 16) suggesting that stocking has enhanced the population. This includes Milburn Beck, Swindale Beck (Trout Beck), Trout Beck, Hilton Beck and Scandal Beck. However the streams may naturally support high densities. Helm Beck was stocked with 25,000 salmon fry in 1991 and only Class D and E were recorded for parr; this is of concern.

Future sampling would be required to determine the natural parr densities in these streams.

The low parr densities caught at the main River Eden sites were probably due to the habitat and sampling reasons described above.

TROUT

At the juvenile stages (fry and parr) it is not possible to differentiate between sea trout and brown trout so the densities recorded may refer to either or both at any one site.

Trout Fry (0+) (Figs 3 and 13)

The trout fry population was generally low in the Upper Eden catchment; 50 of the 69 sites yielding densities in Class D. However some sites supported high populations notably 10 sites in Class B.

Trout fry were present at all but 4 sites in the Upper Eden.

The areas with the highest trout fry densities were:

- The middle reaches of Scandal Beck
- Hilton Beck
- The upper Trout Beck system
- The Crowdundle Beck catchment
- Individual sites in the upper reaches of Helm-Beck and Hoff beck Upper sites on the R. Leith, R. Lyvennet (Class A) and Morland Beck.

These were primarily the most upstream sites, and it is likely that if survey sites were established further upstream on these tributaries it would be found that the narrow streams are the predominant area for trout fry production. This will obviously require further work but if it is the case the trout fry population could be considerably higher than indicated by this survey.

- (b) Sites where the physical habitat was not particularly suitable for juvenile salmonids. At some of these sites the catch was dominated by larger trout which will not be present in the large numbers that would be expected of fry, (one large trout equals a large number of fry in weight terms and so in these cases the low number does not necessarily imply that the fish population should arouse concern).
- (c) Low summer flows.

At the 15 (21%) remaining sites the low densities are of concern ie: The R. Eden from Pendragon Castle (1004) to Kirkby Stephen(1007) 7 sites on the Leith and Lyvennet system, 2 sites on Hoff Beck and individual sites on, Argill Beck, Asby Beck, Augill Beck, Helm Beck and Swindale Beck (Brough). The reasons for the low numbers is not known at these sites.

COARSE FISH

Major Coarse Fish

Eels were recorded at 39 sites but pike, dace and perch were not recorded at any sites in the Upper Eden. The highest eel density was recorded at a site on Helm Beck (1033) at 4.89/100m².

Minor Coarse Fish

Stoneloach, bullhead, minnow, stickleback and lamprey were all recorded (Table 3). Stoneloach, bullhead and minnow were widespread and were abundant at many sites. Stickleback were recorded at 9 sites and lamprey were only caught at 3 sites, all on Trout Beck. The lamprey were not identified to species level.

Table 3 - Minor coarse fish Upper Eden 1992

The number of sites of the 69 surveyed at which each species was present.

Stoneloach	50
Bullhead	55
Minnow	39
Stickleback	9
Lamprey	3

PRODUCTION BY REACH

To manage a fishery effectively it is important to know the numbers of fish produced in different parts of the catchment. This is not necessarily the sites with the highest densities. A large stream area producing a low density is likely to produce more fish than a small area yielding a high density. The calculations are based upon stream areas (length x width) multiplied by fish densities. The lengths used normally extend 0.5km upstream of the most upstream site on each reach. The widths are those measured during the survey. Notes and assumptions are presented in Appendix 3. On most streams there is still a significant length upstream of the top site which is therefore not included in the production estimates. As discussed later, this may be significant, particularly for trout fry production. Data for salmon and trout are shown in tables 4 and 5 respectively. Data for salmon and trout are shown in Tables 4 and 5 respectively.

Salmon (Table 4)

The main salmon fry producing areas were:-

River Eden, Stenkrith to Appleby	19.9%
River Eden, Appleby to Temple Sowerby	16.0%
River Belah	14.2%
Leith and Lyvennet catchment	11.0%

In total they account for 61% of the estimated production in 1992.

For salmon parr the main producing areas were;

River Eden, Appleby to Temple Sowerby	10.2%
Scandal Beck	18.6%
Hilton Beck	16.2%
Crowdundle Beck	27.9%

These account for 73% of the estimated parr production in 1992.

It is important to note that this does not include unsurveyed streams.

Shearer (1984a) estimates that survival from parr to 2+ smolt is approximately 50% and that survival at sea is 20-30% for grilse. If these estimates are applied to total parr numbers this would yield 32.8 thousand smolts and an estimated grilse return of 6550 to 9850.

However work in Northern Ireland (Kennedy, in Solomon 1983) estimates the smolt to grilse survival to range from 3-13%. For this data this would yield 980 to 4250 grilse.

How these survival estimates relate to fish from the Upper Eden is unknown.

Fry/Parr Ratio

There is a need for caution when comparing the abundance of one year class (eg fry) with another (eg parr) to infer survival from one to another. This is because year class strengths naturally vary greatly. The following discussion assumes that natural year class strength is constant.

The abundance category system used in the N.R.A. North West is based on a significant background of survey data and is based on the assumption that 1 in 5 fry survive to become parr, ie. a parr/fry ratio of 0.2.

The overall parr/fry ratio for this survey was 0.27. Streams with higher ratios than 0.27 (ie with higher than expected parr numbers) were all stocked in 1991 (ie. the parr class) (Table 4). However Helm Beck was also stocked in 1991 and yielded the lowest ratio of 0.03 indicating the failure of the 1991 stocking of 25.4 thousand fry.

Swindale Beck (Dufton) yielded a particularly high ratio of 10 which suggests that the 1991 stocking of 5 thousand fry was highly successful.

The low ratio on Argill Beck is due to the lack of suitable habitat for parr in the survey area.

Table 4

Upper Eden Survey 1992
Salmon Production Figures by Reach
 (S indicates stocking of that year class)

	<u>Fry</u>	<u>Parr</u>	<u>Ratio</u> <u>Parr/Fry</u>
<u>Eden</u>			
Hanging Lund to Stenkrith	10955 S	-	-
<u>Eden</u>			
Stenkrith to Appleby	48246	2777	0.06
<u>Eden</u>			
Appleby to Temple Sowerby	38740	6671	0.17
<u>Scandal Beck</u>	15799	12208 S	0.77
<u>River Belah</u>	34569	4666	0.14
<u>Argill Beck</u>	4830	191	0.04
<u>Augill Beck</u>	2544	-	-
<u>Swindale Beck</u> (Brough)	2448 S	-	-
<u>Helm Beck</u>	5231	170 S	0.03
<u>Hilton Beck</u>	11653	10634 S	1.00
<u>Hoff Beck</u>	11246	1637	0.14
<u>Trout Beck</u>	10022	4631 S	0.45
<u>Swindale Beck</u> (Dufton)	178	2124 S	10
<u>Leith and Lvennet</u>	26790 S	1347	0.05
<u>Crowdundle Beck</u>	20084	18285 S	0.91
TOTAL	242872	65641	0.27

Table 5**Upper Eden Survey 1992
Trout Production Figures by Reach**

	<u>Fry</u>	<u>Older Trout</u>
<u>Eden</u>		
Hanging Lund to Stenkrith	2957	3929
<u>Eden</u>		
Stenkrith to Appleby	3233	3722
<u>Eden</u>		
Appleby to Temple Sowerby	1611	4951
<u>Scandal Beck</u>	29461	4319
<u>River Belah</u>	1492	1065
<u>Argill Beck</u>	765	260
<u>Swindale Beck</u> (Brough)	227	1262
<u>Augill Beck</u>	509	74
<u>Crooks/Hayber Beck</u>	881	388
<u>Helm Beck</u>	6927	930
<u>Hilton Beck</u>	4231	4217
<u>Asby Beck</u>	4458	797
<u>Hoff Beck</u>	3844	1722
<u>Scale Beck</u>	544	741
<u>Brampton Beck and</u> <u>Troutbeck</u>	7687	6772
<u>Swindale Beck</u> (Dufton)	5007	3038
<u>River Lyvennet</u>	12258	4445
<u>River Leith</u>	4623	0

Table 5 (Continued)

Upper Eden Survey 1992
Trout Production Figures by Reach

	<u>Fry</u>	<u>Older Trout</u>
<u>Ravensgill</u>	716	70
<u>Morland Beck</u>	1510	428
<u>Crowdundle Beck</u>	8320	3275
<u>Milburn Beck</u>	7417	3674
TOTAL	108678	50079

Trout (Table 5)

The total estimated trout fry production is less than half that for salmon fry. The older trout numbers are also lower, (approximately 75%) than salmon parr, but these are not strictly comparable because the trout population will consist of a larger range of year classes. It is also important to realise that older trout will principally inhabit deeper waters that were not part of this survey and so these figures will be a minimum estimate of the numbers of trout present.

Trout fry production was less clumped than for salmon with only two streams producing more than 10% of the total. These were;

Scandal Beck	27.1%
River Lyvennet	11.3%

Together these contribute 38% of the estimated fry production.

For older trout the most important areas were

Trout/Brampton Beck	13.5%
River Eden Appleby to Temple Sowerby	9.9%

As for trout fry older trout were much more evenly distributed than salmon parr.

Due to the difference in life history trout fry numbers do not appear to be as high as those for salmon fry in order to sustain the population. Because adult trout are repeat spawners they represent several year classes of fish. Thus, in order to sustain the adult population, a smaller proportion of trout need to be recruited to adulthood each year than for salmon. The majority of adult salmon spawn once and are grilse, consisting mostly of one or two year classes, and so annual recruitment needs to be high. Therefore the low production for trout may not be as poor as it appears at first.

DISCUSSION AND CONCLUSIONS

Although there are sites with low salmonid densities which cause concern the general impression is that the Eden catchment is healthy for Salmonids with 36% of the 69 sites surveyed yielding total salmonid densities of Class B or better. Almost 15% yielded Class A.

The highest salmonid densities were found on the Pennine streams from Crowdundle to Hilton Beck and also on Scandal Beck. On some of these streams the densities may have been enhanced by stocking with salmon fry in 1991 although it is possible that the high densities are natural.

Salmon fry were widespread, most tributaries had sites with both high and low densities. Poor populations on the Leith and Lyvennet appear to be maintained purely by stocking with large numbers, with virtually no apparent natural production.

Salmon parr were less widespread than fry but more sites supported high density classes. Despite stocking in 1991 Helm Beck parr densities were low or absent.

Trout fry densities are generally low although there are some sites with excellent densities. Older trout populations were generally good especially in the upper reaches of many streams. However older trout were absent or low at several sites, those of concern being Helm Beck, and the Leith and Lyvennet system.

Generally the Lyvennet and Leith catchment did not yield a healthy salmon or trout population.

- Salmon numbers appeared to be influenced by stocking, but, even when stocked, densities were low.
- The trout population was seriously low in the Leith and of concern in some parts of the Lyvennet.
- However excellent trout fry densities (the highest for the Upper Eden survey) were found at the upper sites on the Lyvennet and good densities on the uppermost site on the Leith; otherwise fry densities were low. At Woodfoot Bridge (1054) the stream almost dries up in summer; consequently a low density would be expected.

Eel, stone loach, bullhead and minnow were widespread: stickleback and lamprey were less common. No other major coarse fish were caught.

Estimated production figures for each reach showed that for both age classes there were more salmon than trout. Salmon had a more clumped distribution than trout with only 4 reaches accounting for 61% of salmon fry and 73% of salmon parr production.

Ratios of fry/parr suggest that fry stocking in 1991 was successful at most sites but failed badly in Helm Beck. This conclusion should be viewed with caution as year class strengths naturally vary greatly.

STREAM REACHES OF CONCERN
(Discussion and Recommendations)

LEITH AND LYVENNET

Follow-up Survey

A follow-up survey was conducted in June 1994. Fourteen sites were surveyed from Maulds Meaburn downstream on the Lyvennet and from Shap downstream on the Leith.

The results were promising showing an improvement in older trout densities at almost all sites. On the Leith all sites supported older trout populations, some sites had high densities in classes B and C; this was a significant improvement compared to the absence of older trout found in 1992. However, salmon parr densities were low which indicates that there is limited natural recruitment.

Salmonid fry were small and therefore not identifiable to species level. However, total fry densities were lower than in 1992, probably because the densities were not enhanced as they were in 1992 by stocking.

The improvement in older trout densities is likely to be due to Water Quality improvements following the Pollution Control Campaign conducted in 1992.

A smolt trap was installed in the lower reaches of the Lyvennet to monitor the smolt production from the catchment if successful this would give us additional information about migratory fish production in this system to compare with the electrofishing data. The trap was sited at N.G.R. NY608 256 from April 21st to June 13th. A total of 206 smolts were trapped; the last smolt being trapped on May 20th. All smolts were salmon. The trap suffered flood damage on 2 occasions and it is likely that a significant number of smolts passed downstream while the trap was out of operation.

Caged fish were sited in the Leith and Lyvennet to assist with detection of intermittent pollution. However, these were subsequently considered unnecessary when the follow-up survey demonstrated the improvement in the older trout population.

Recommendations

1. Electrofish the survey sites listed below in 1996 to assess whether improvements have continued.
2. Continue to monitor the smolt production in 1995 by installing the smolt trap from April to mid June. This data can be used to evaluate the production of migratory salmonids and relate it to production estimated from electrofishing data.
3. Reaches should be selected for river corridor and channel survey to determine whether habitat improvement is necessary and what methods would be appropriate. Initial reach selection should be based on site visits and discussions with the local Water Bailiff.

Recommended Site List for Leith and Lyvennet

<u>Site Number</u>	<u>Stream Name</u>	<u>Site</u>	<u>NGR</u>
1,052.00	River Lyvennet	Crosby Lodge Farm	NY621126
1,054.00	River Lyvennet	Woodfoot Bridge	NY623137
1,055.00	River Lyvennet	Crosby Ravensworth	NY624148
1,056.00	River Lyvennet	In Maulds Meaburn	NY626164
1,056.10	River Lyvennet	Maulds Meaburn	NY625166
1,057.00	River Lyvennet	At Meaburn Hall	NY624172
	River Lyvennet	Barnskew	NY621188
1,058.00	River Lyvennet	At Kings Meaburn	NY618213
	River Lyvennet	Kemplee	NY614219
1,059.00	River Lyvennet	At Woodhead	NY613231
1,060.00	River Lyvennet	At Brigham Bank	NY600248
1,060.10	River Lyvennet	Brigham Bank	NY603252
1,061.30	Morland Beck	U/s Morland	NY603221
1,061.40	Morland Beck	D/s Morland	NY597229
1,062.00	Morland Beck	At Glenton Vale	NY598231
1,062.10	River Leith	ARC Quarry Shap	NY554176
	River Leith	Shapbeck Gate	NY557186
	River Leith	Thrimby	NY557202
1,063.00	River Leith	At Great Strickland	NY551227
1,064.00	River Leith	At Melkinthorpe	NY556250
1,064.50	River Leith	Wood House Farm	NY572252
1,064.60	River Leith	Ling Farm	NY574247
1,065.00	River Leith	At Cliburn	NY588244

HOFF BECK

Follow-up Survey

A follow-up survey was conducted downstream of Rutter Force in November 1993. Six sites were surveyed, 3 were additional to those in the 1992 survey.

There was an increase in the density of older trout present at Brandley Bridge (1042), but at most other sites the densities of each salmonid age class were similar to those found in 1992. There was a slight decrease at Hoff (1041). One grayling was caught at Brandley Bridge (1042) although the habitat surveyed was not particularly suitable and they would not normally be expected. Neither chemical nor biological water quality data indicate a water quality problem.

Recommendations

Reaches should be selected for river corridor and channel survey to determine whether habitat improvement is necessary and what methods would be appropriate. Initial reach selection should be based on site visits and discussions with the local Water Bailiff.

SWINDALE BECK CATCHMENT (BROUGH)

There were 4 sites on this catchment; 2 on Swindale Beck and 2 on Augill Beck. On each stream one site was upstream of an impassable barrier.

In 1992 pollution caused a fish kill at Hall Garth. Subsequently 20,000 salmon fry were stocked prior to the survey in the 3km section from Brough downstream to the Eden. Brown trout were also stocked upstream of Brough and in Augill Beck downstream of the A66.

The last kilometre of Swindale Beck prior to the Eden confluence has been subject to Flood Defence works which has left limited bankside cover especially during low summer flows.

Filamentous algae is abundant for approximately 1.5km upstream of the Eden.

As expected salmon were not recorded at the sites upstream of the barriers (1027, 1029). Downstream the salmon fry density was low in Swindale Beck but good in Augill Beck yielding a Class C. Salmon parr were not found.

The site on Swindale Beck was within the engineered section and would be expected to produce lower densities than the natural section upstream. This effectively means that as these "lower densities" were used to calculate the production figures for the whole reach, the salmon fry production figure of just over 2,400 (Table 4) will probably be a slightly low estimate of the numbers present. This however, is unlikely to account for the large difference between 2,400 and the 20,000 stocked fry. This large difference indicates not only poor survival of the stocked fish but also low natural recruitment; an observation supported by the fact that the local Water Bailiff annually finds that very few salmon spawn in Swindale Beck.

Trout fry densities were low at all sites, and older trout were not found at the two sites downstream of the barriers (1030, 1028). The site on Swindale Beck upstream of Brough produced Class A densities of older trout.

The filamentous algae downstream of Brough may affect fish populations by physically reducing the space available. The algae may also reduce the dissolved oxygen concentration as photosynthetic plants only produce oxygen in light. At night they respire, utilising oxygen from the surrounding water. The higher the water temperature the less oxygen it can contain and so in summer luxuriant algal growths can cause fatal drops in dissolved oxygen levels.

To manage this fishery effectively it is important to know:-

1. What the current salmonid stocks are and if they are as low as found in 1992.
2. Whether salmon and trout parr are still absent. Whether their absence in 1992 was due to an absent year class.
3. Whether there is any significant natural recruitment for salmon in this system.
4. Whether higher trout fry densities are found further upstream in Swindale Beck as found on other Eden tributaries.
5. Whether, if the populations are still below what would be expected, water quality factors or physical habitat could be limiting production.

Recommendations

It is recommended that:-

1. A further electrofishing survey is conducted with additional sites as indicated below. These sites are subject to accessibility.
2. A river corridor and channel survey is conducted to assess the requirement for habitat improvement downstream of Brough. Priority should be given to the section worked by Flood Defence.
3. The reason for the abundant algal growth is investigated, initially by a site visit.

Recommended Site List

<u>Swindale Beck</u>	<u>Site No.</u>	<u>Approx N.G.R.</u>
1 Near Seavy Rigg		NY818 182
2 Near Woodside		NY807 168
3 At NY804 153		NY804 153
or NY802 149		NY802 149
4 U/s Brough	1027	NY797 147
5 Church Brough		NY793 142
6 D/s Church Brough		NY783 139
7 Hall Garth	1028	NY775 136
8 D/s Hall Garth		NY772 134

Augill Beck

Site No.

Approx N.G.R.

9	Near Forest Farm		NY811-145
10	At NY804 144		NY804 144
11	At Church Brough	1030	NY797 141

RIVER EDEN PENDRAGON CASTLE TO KIRKBY STEPHEN

There were 4 sites in this reach of approximately 7km. The mean width ranged from 7.4 to 14.3m and caused no sampling difficulties.

The salmonid densities were low for both age classes of salmon and trout except for a Class C for >0+ trout at Wharton Hall.

There is no known problem with water quality which is always good and the invertebrate fauna is diverse and abundant.

It is likely that physical habitat is restrictive, this reach flows over open land with little or no tree or marginal or cover.

Recommendations

A river corridor and channel survey should be conducted to determine whether habitat improvement is necessary and what methods would be appropriate.

HELM BECK

Three sites were surveyed.

Salmonid fry densities were good at the two upstream sites. At Grizeburn the fry were all trout whereas at Helm Beck Cottage both salmon and trout were present. The Fry density was poor at Little Ormside. At all 3 sites the >0+ trout density was low.

The most significant feature was the failure of the 1991 stocking of 25,400 fry; only 2 salmon parr were found. This provided an estimated population of 170 parr for the surveyed area of Helm Beck, ie. 0.7% of those stocked. Compared to values found in survival studies conducted in the North West by the N.R.A., this value was particularly low. The mean survival found in these studies was 10% which would have resulted in approximately 2,500 parr from this stocking.

Recommendations

1. Helm Beck should not be stocked with salmon fry in future unless the reasons for stocking failure are identified and rectified if appropriate.
2. To assess whether the current stock in the lower reaches of Helm Beck is as poor as recorded in 1992 an electrofishing survey should be conducted at the following sites.

<u>Site</u>	<u>Archive No.</u>	<u>Approx N.G.R.</u>
1. Helm Beck Cottage	1033	NY709 149
2. At NY706 158		NY706 158
3. Little Ormside	1034	NY702 165
4. Little Ormside		NY707 168

3. Follow up water quality and river corridor and channel surveys should be initiated if populations are found to be lower than expected.

OTHER RECOMMENDATIONS

Survey results from other catchments as well as the Upper Eden have demonstrated that trout fry densities were generally low but were higher in the most upstream sites.

This should be investigated further to determine whether or not the high densities continue to occur further upstream and therefore whether overall trout fry production is as low as indicated by the survey. It is important to determine the contribution of small streams to the trout population.

For the Upper Eden it is estimated that, if the stream lengths used in the calculations were extended further upstream, approximately 10% more productive area would be included in the calculations. If this area is multiplied by the trout fry densities at the most upstream sites the increase in productivity figures could be as high as 40%.

The question of trout fry productivity in smaller/more upland streams is a general question rather than one specifically related to the Upper Eden. It is recommended that sites further upstream on some watercourses should be included in future strategic surveys. This additional workload will need to be consistent with available resources.

REFERENCES

Farooqi M. and Aprahamian M W 1993

The calibration of a semi Quantitive approach to Fish Stock Assessment in the North West Region of the N.R.A. NRA/NW/FTR/93/4.

Shearer 1984a

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Solomon 1993

Determining the role of restocking in Fisheries Management, Welsh Rivers - Stocking and Taking Stock; Proceedings of the joint N.R.A. Welsh Region/WSTAA Seminars 1993. N.R.A. Welsh Region Technical Fisheries Report No. 4.

LIST OF FIGURES

- A Upper Eden Survey Area
- B Leith and Lyvennet Survey Area

Upper Eden Catchment

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- 2. Salmon Parr Densities
- 3. Trout Fry Densities
- 4. Trout Parr Densities
- 5. Total Salmonid Density Index
- 6. Stocking Data 1991
- 7. Stocking Data 1992
- 8. Redd Counts 1990
- 9. Redd Counts 1991
- 10. Known Obstacles to Migratory Fish

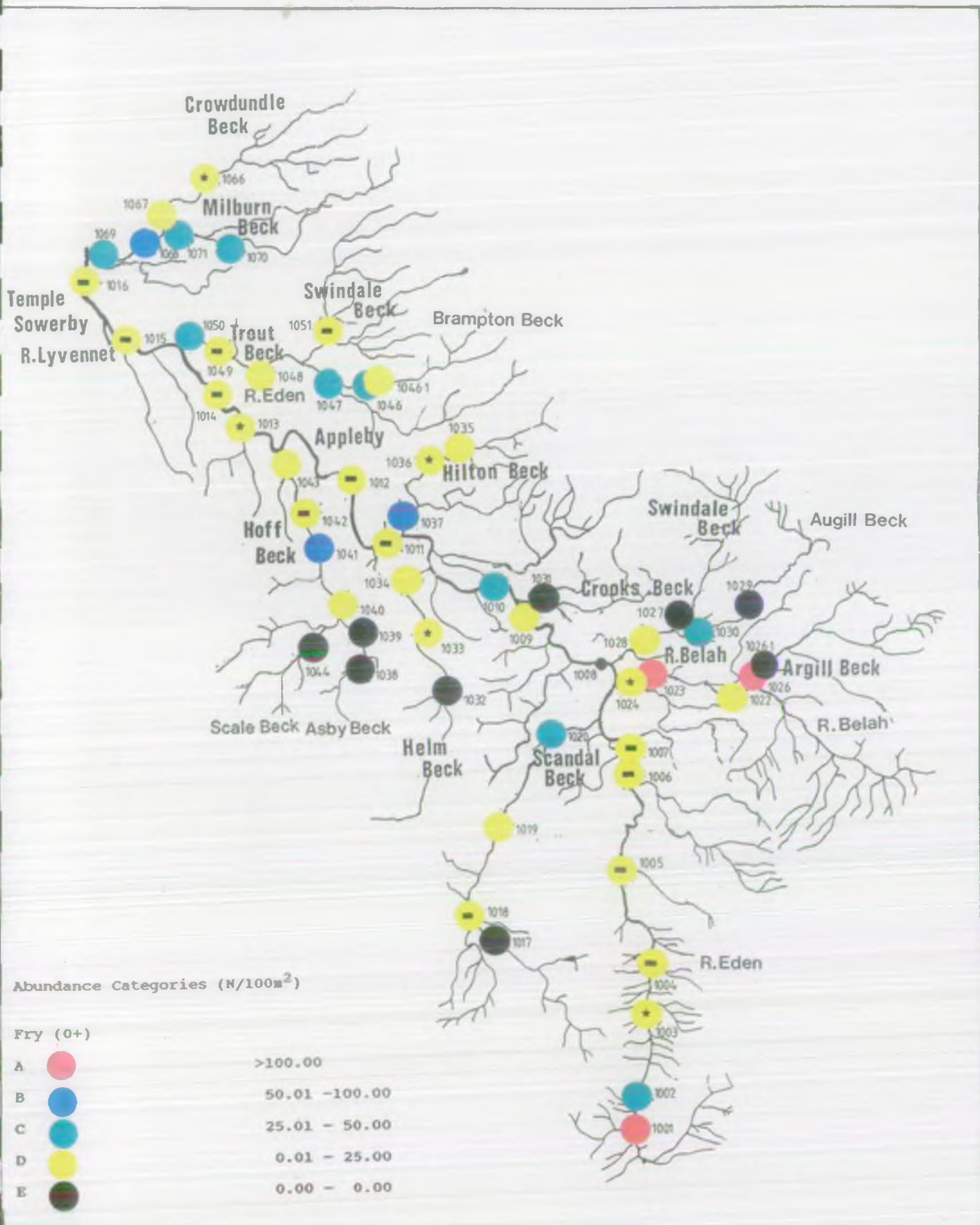
Leith and Lyvennet Catchment

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- 19. Redd Counts 1991
- 20. Known Obstacles to Migratory Fish

UPPER EDEN CATCHMENT

Figure 1

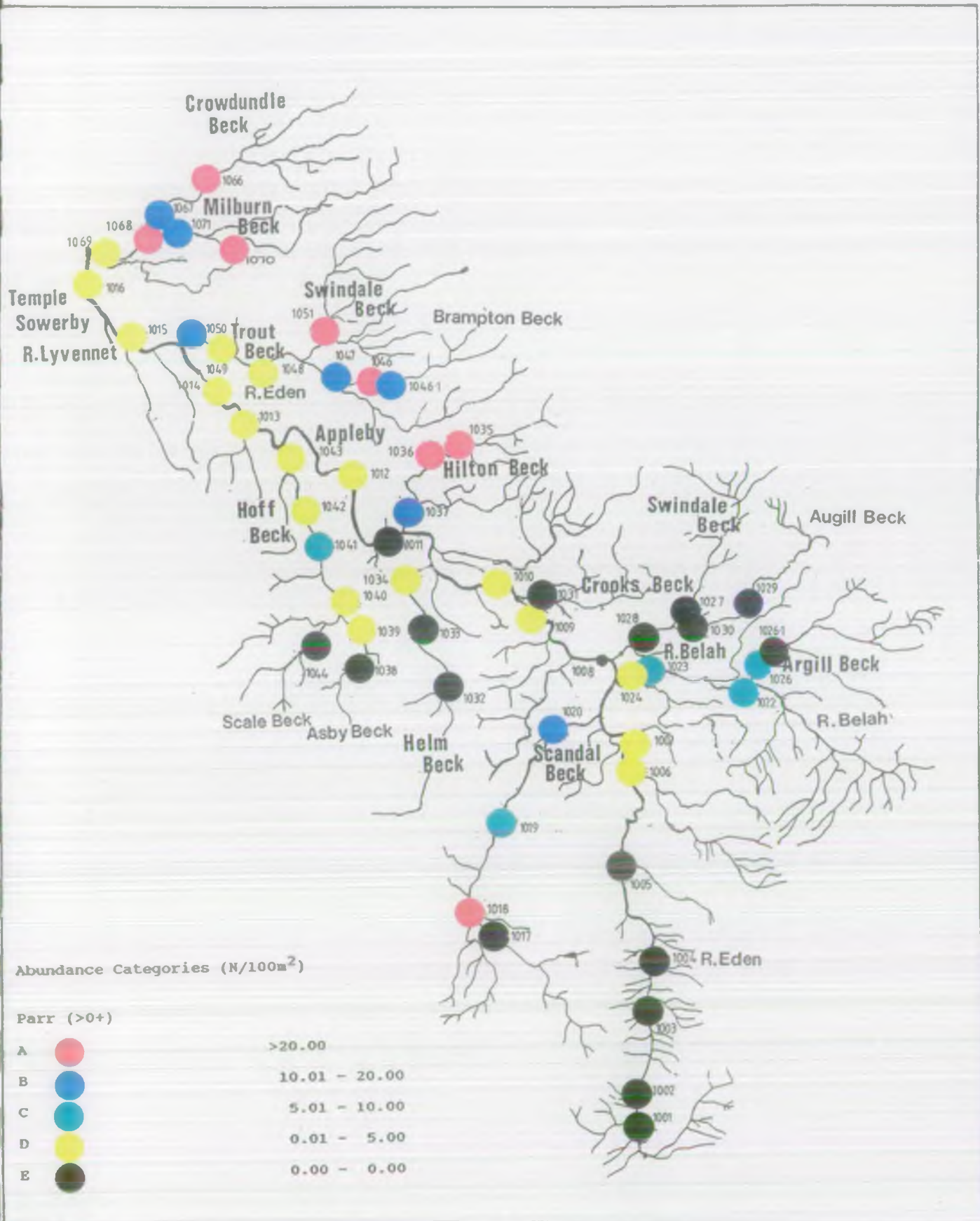
Salmon Fry (0+) Densities In 1992



UPPER EDEN CATCHMENT

Figure 2

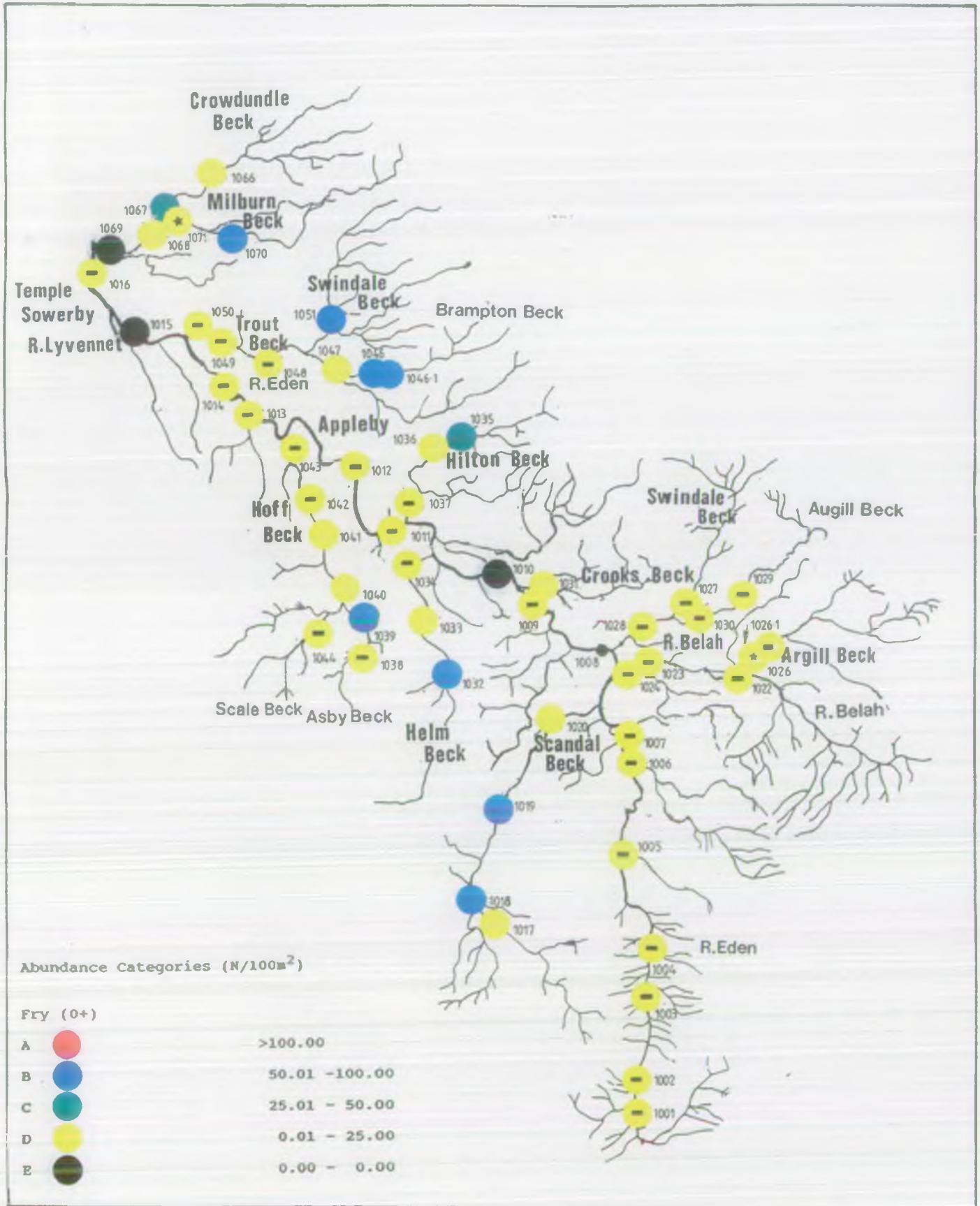
Salmon Parr (>0+) Densities In 1992



UPPER EDEN CATCHMENT

Figure 3

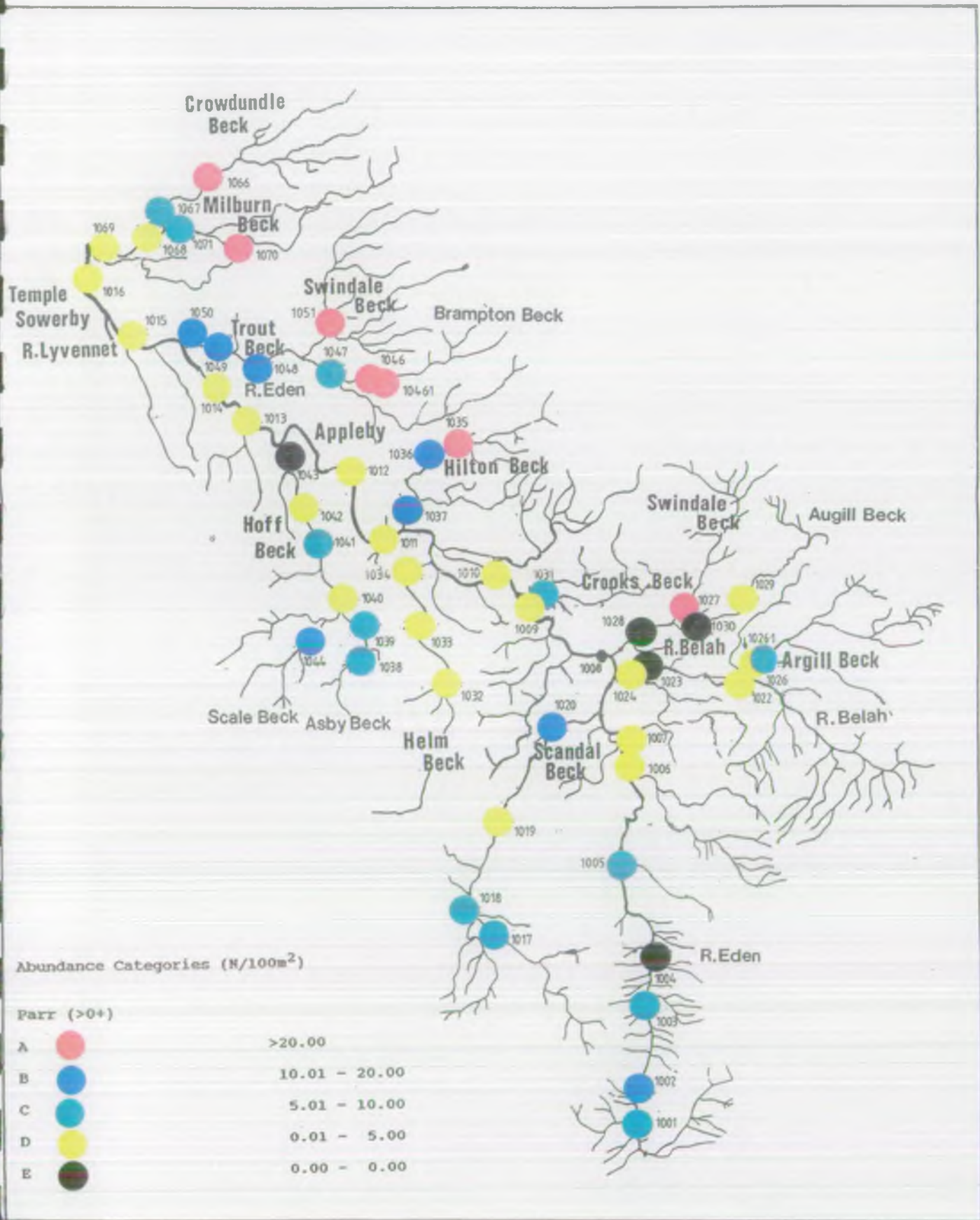
Trout Fry (0+) Densities In 1992



UPPER EDEN CATCHMENT

Figure 4

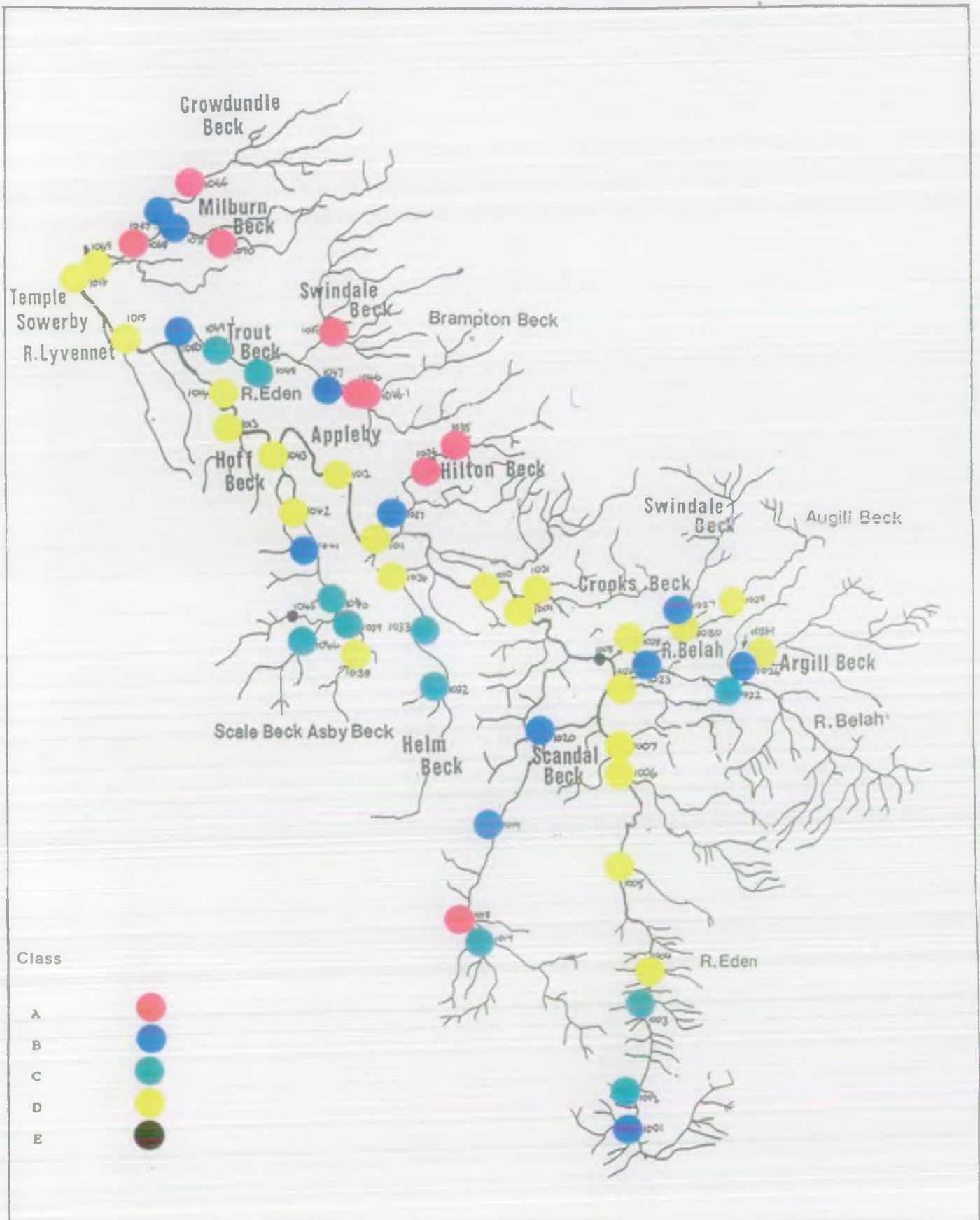
Trout (>0+) Densities In 1992



UPPER EDEN CATCHMENT

Figure 5

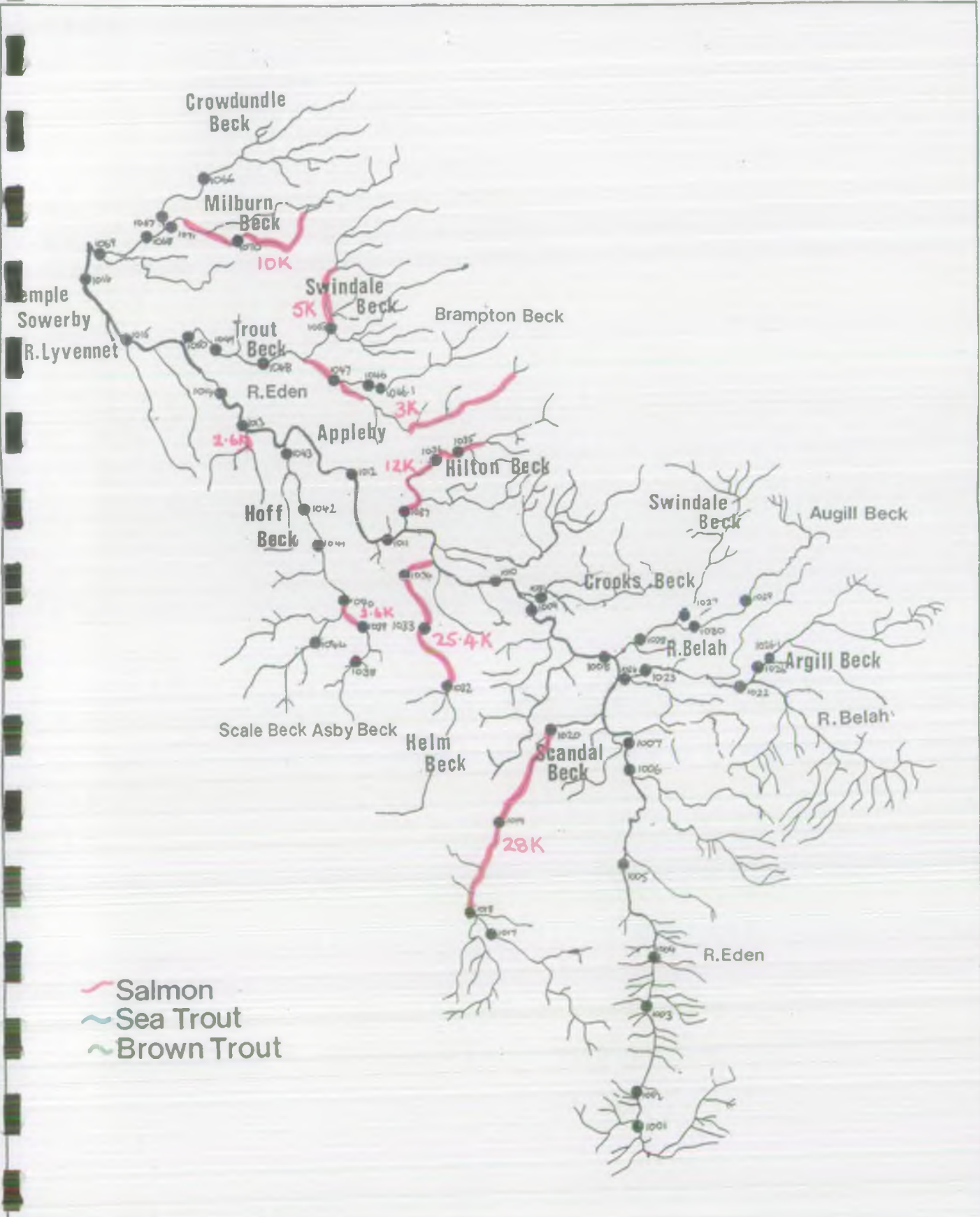
Total Salmonid Density Class 1992



UPPER EDEN CATCHMENT

Figure 6

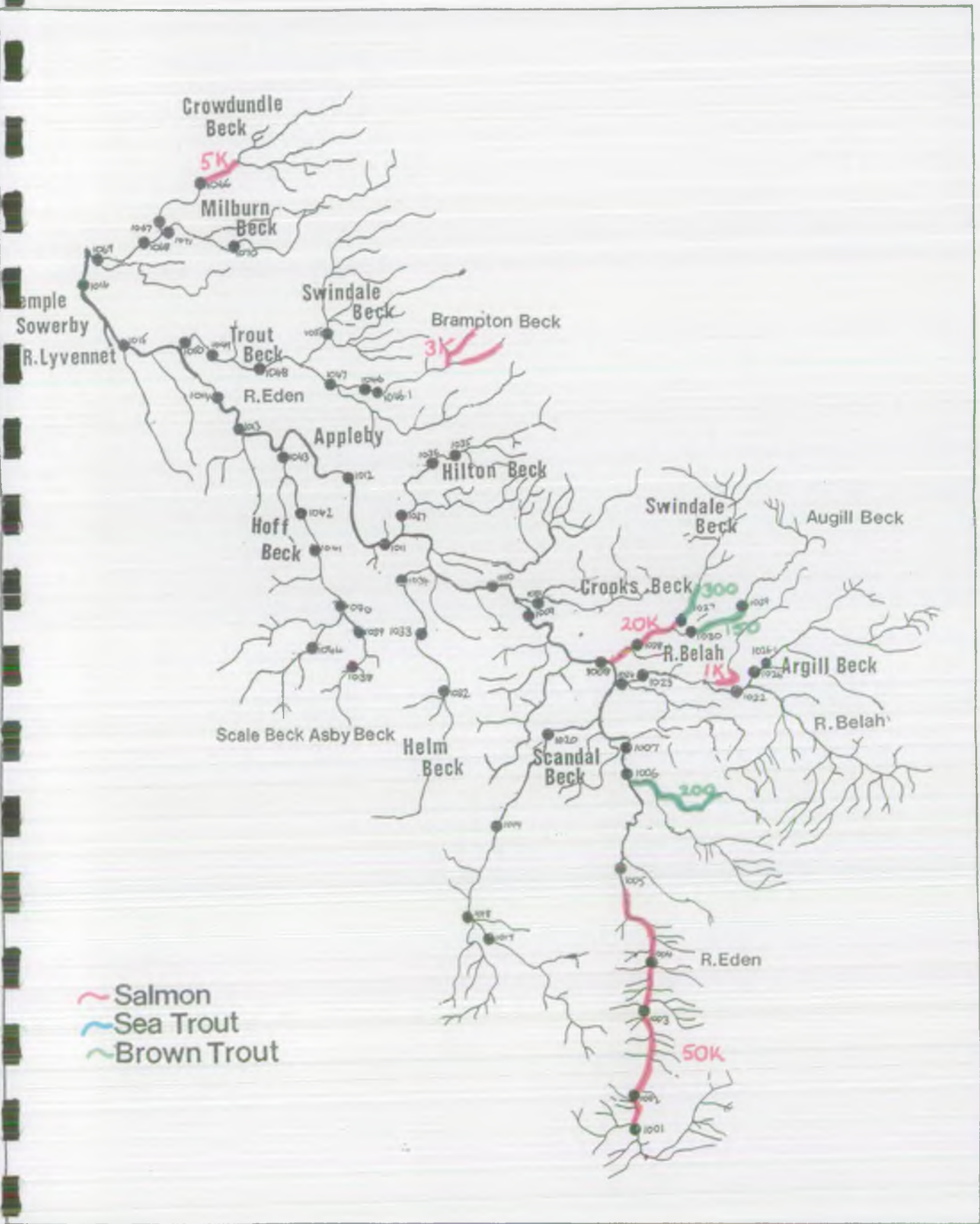
Stocking Data 1991



UPPER EDEN CATCHMENT

Figure 7

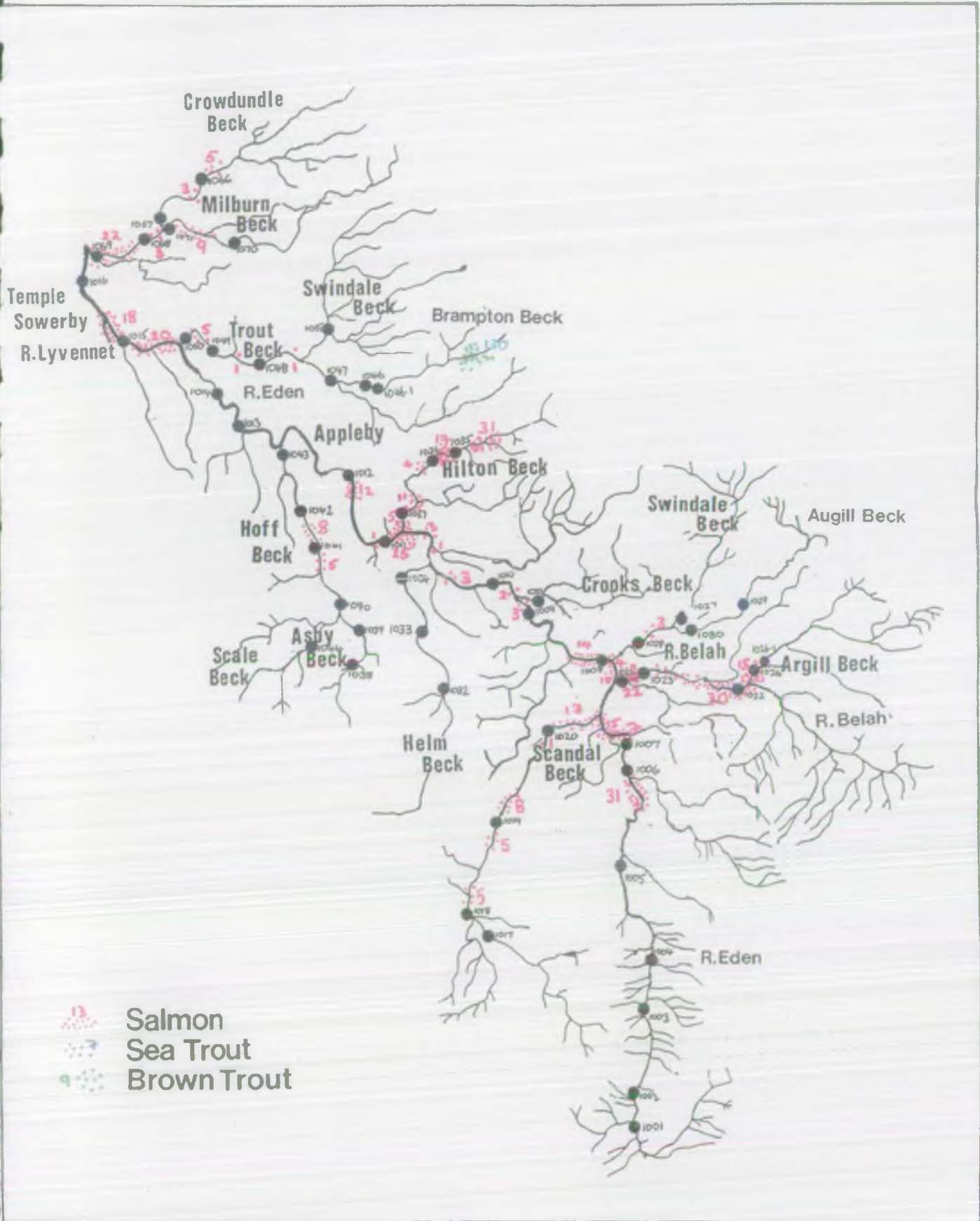
Stocking Data 1992



UPPER EDEN CATCHMENT

Figure 9

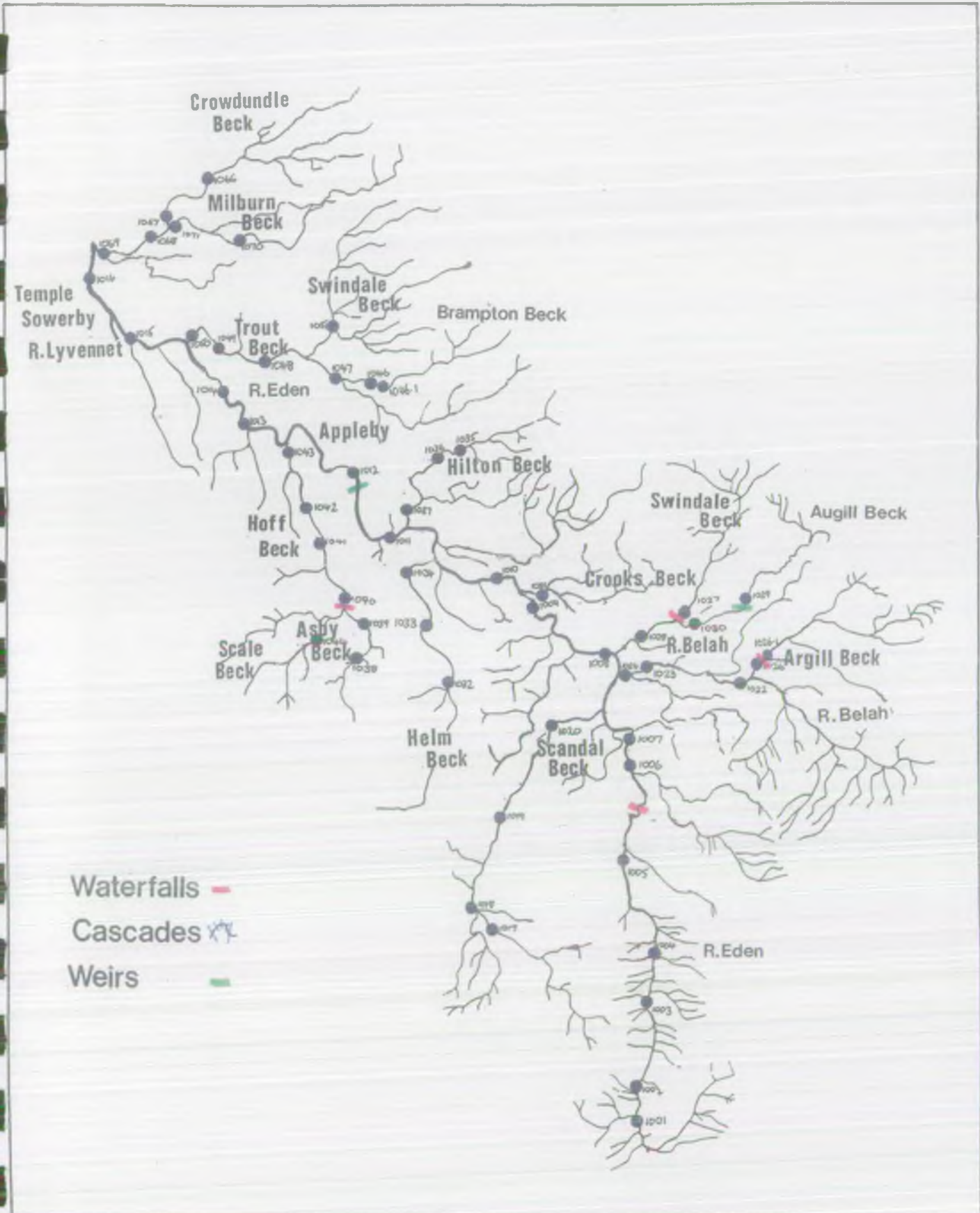
Redd Counts 1991



UPPER EDEN CATCHMENT

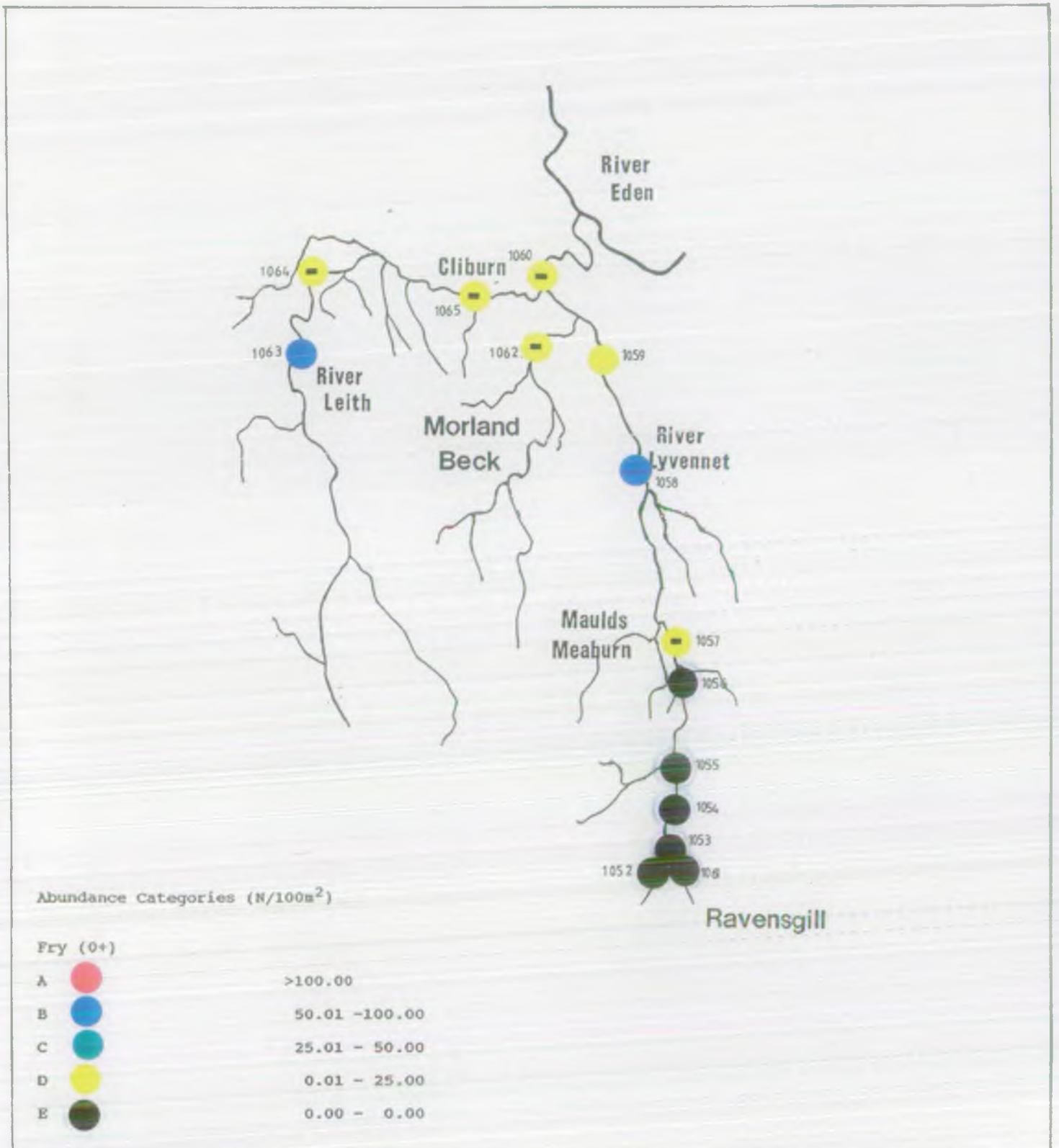
Figure 10

Known Obstacles To Migratory Fish - 1992



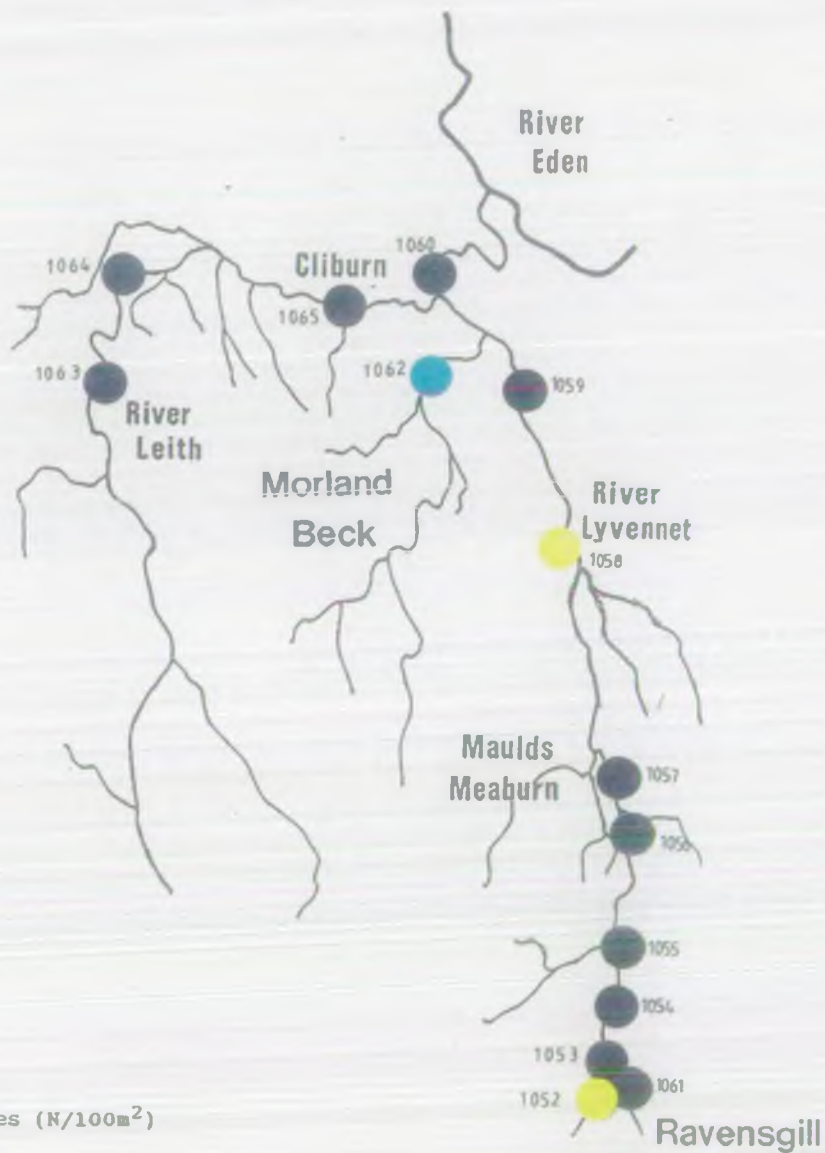
LEITH, LYVENNET CATCHMENT

Salmon Fry (0+) Densities In 1992



LEITH, LYVENNET CATCHMENT

Salmon Parr (>0+) Densities In 1992



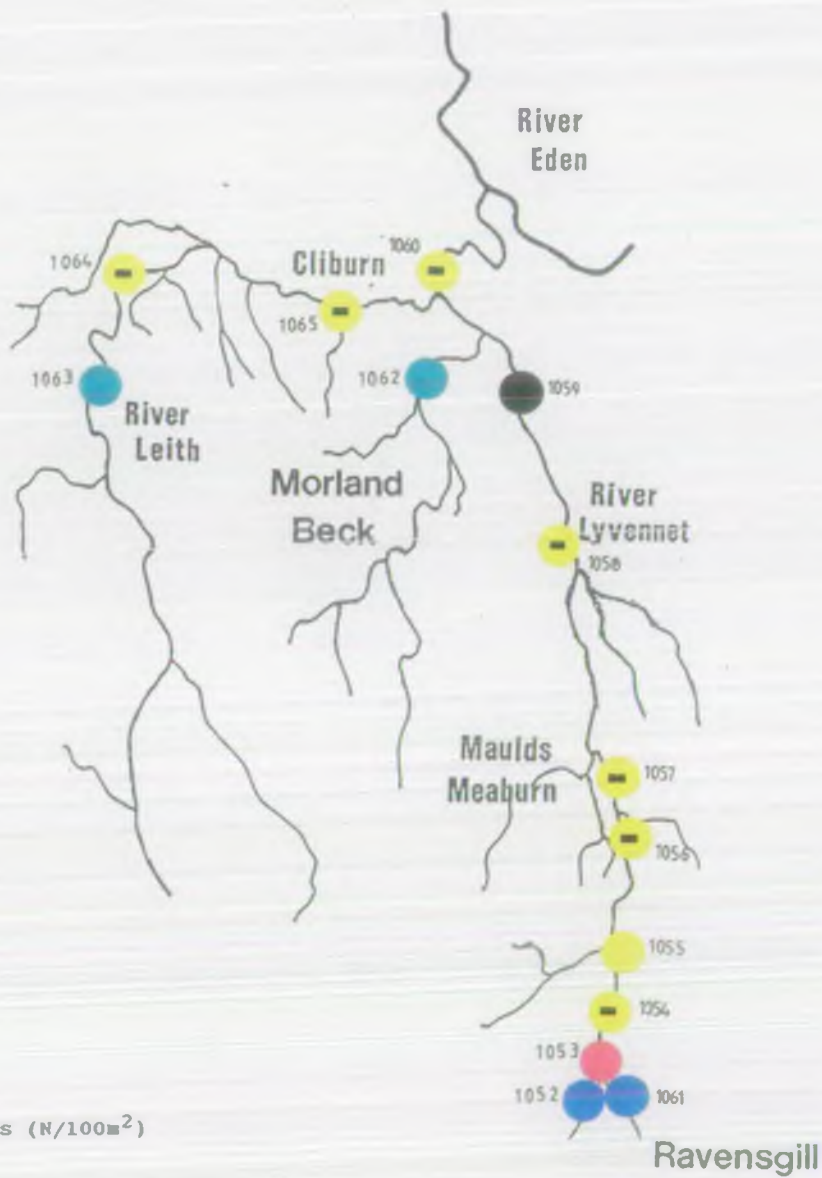
Abundance Categories (N/100m²)

Parr (>0+)

A	(Red circle)	>20.00
B	(Blue circle)	10.01 - 20.00
C	(Cyan circle)	5.01 - 10.00
D	(Yellow circle)	0.01 - 5.00
E	(Dark grey circle)	0.00 - 0.00

LEITH, LYVENNET CATCHMENT

Trout Fry (0+) Densities In 1992



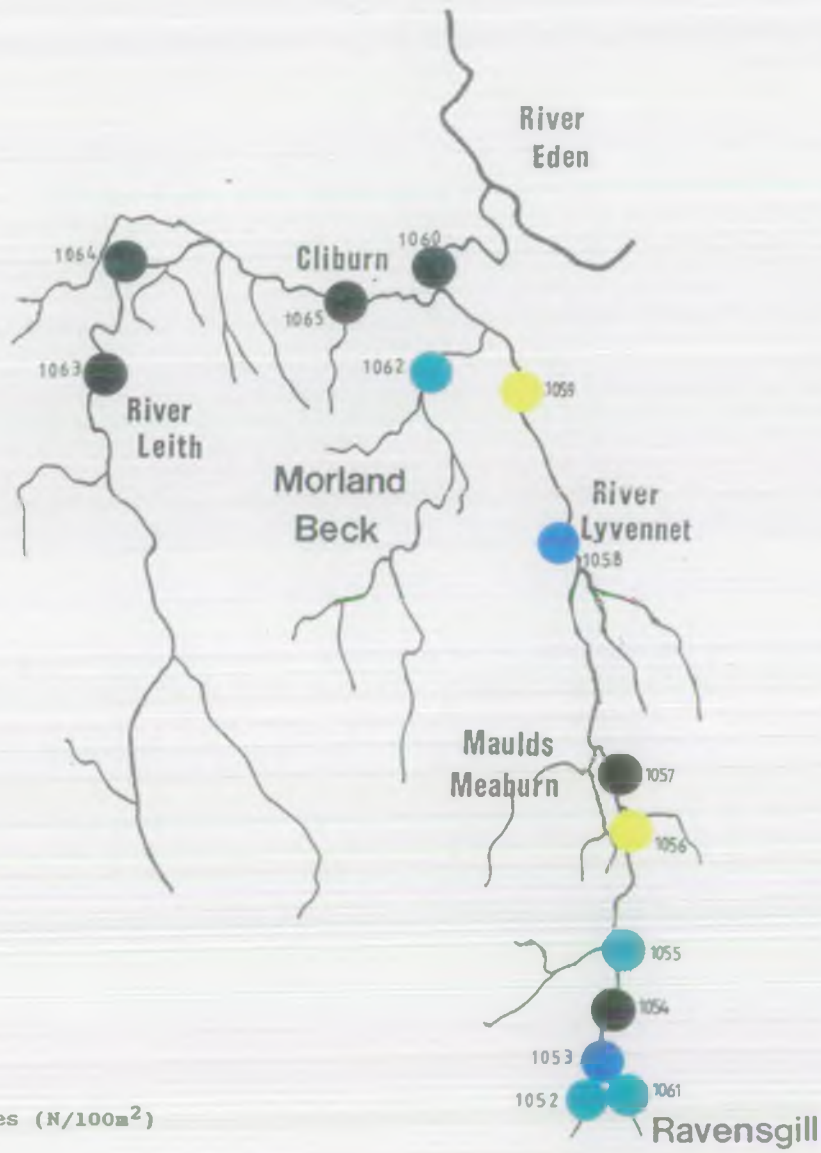
Abundance Categories (N/100m²)

Fry (0+)

A		>100.00
B		50.01 - 100.00
C		25.01 - 50.00
D		0.01 - 25.00
E		0.00 - 0.00

LEITH, LYVENNET CATCHMENT

Trout (>0+) Densities In 1992



Abundance Categories (N/100m²)

Parr (>0+)

A		>20.00
B		10.01 - 20.00
C		5.01 - 10.00
D		0.01 - 5.00
E		0.00 - 0.00

LEITH, LYVENNET CATCHMENT

Total Salmonid Density Class 1992

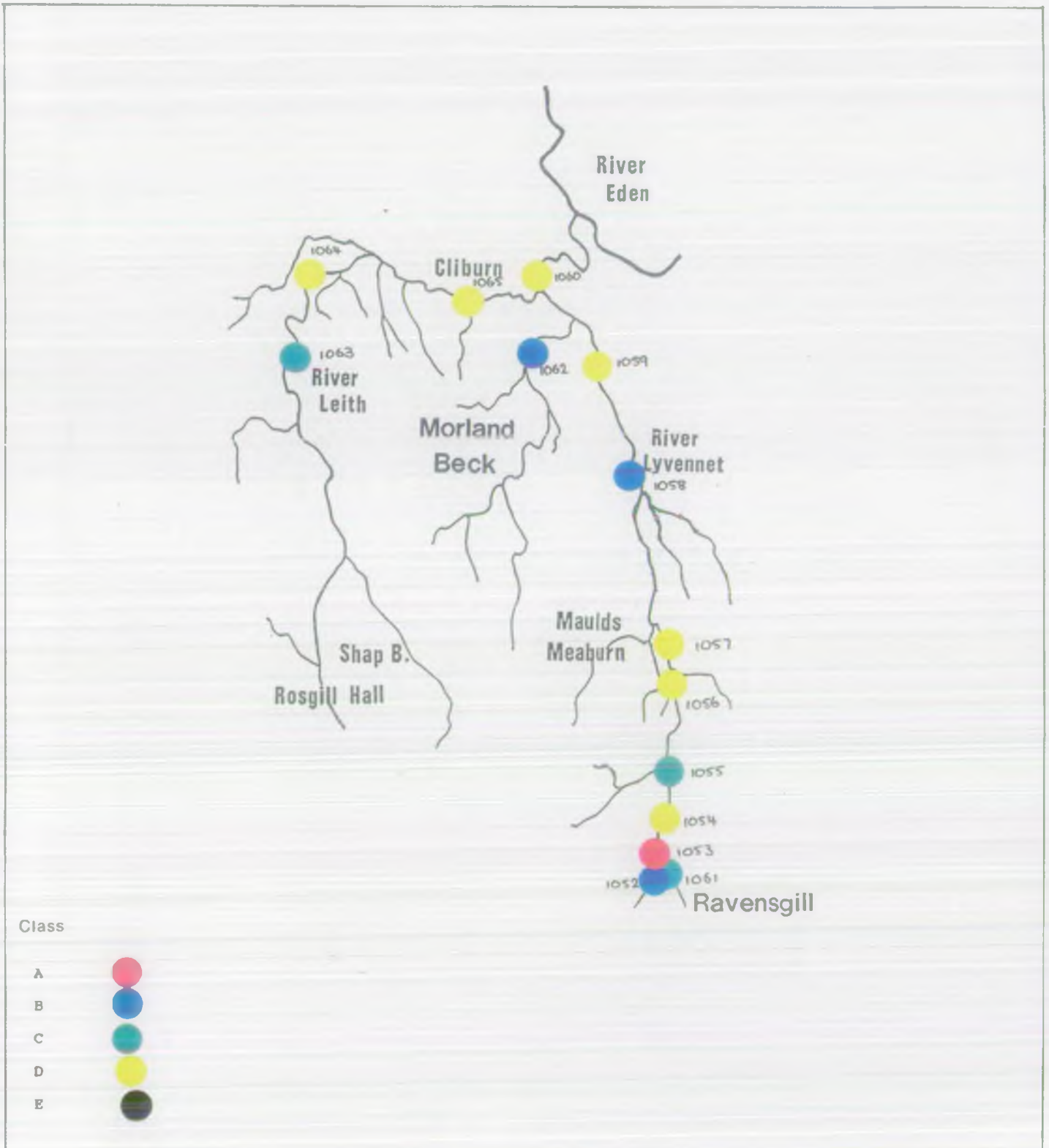


Figure 16

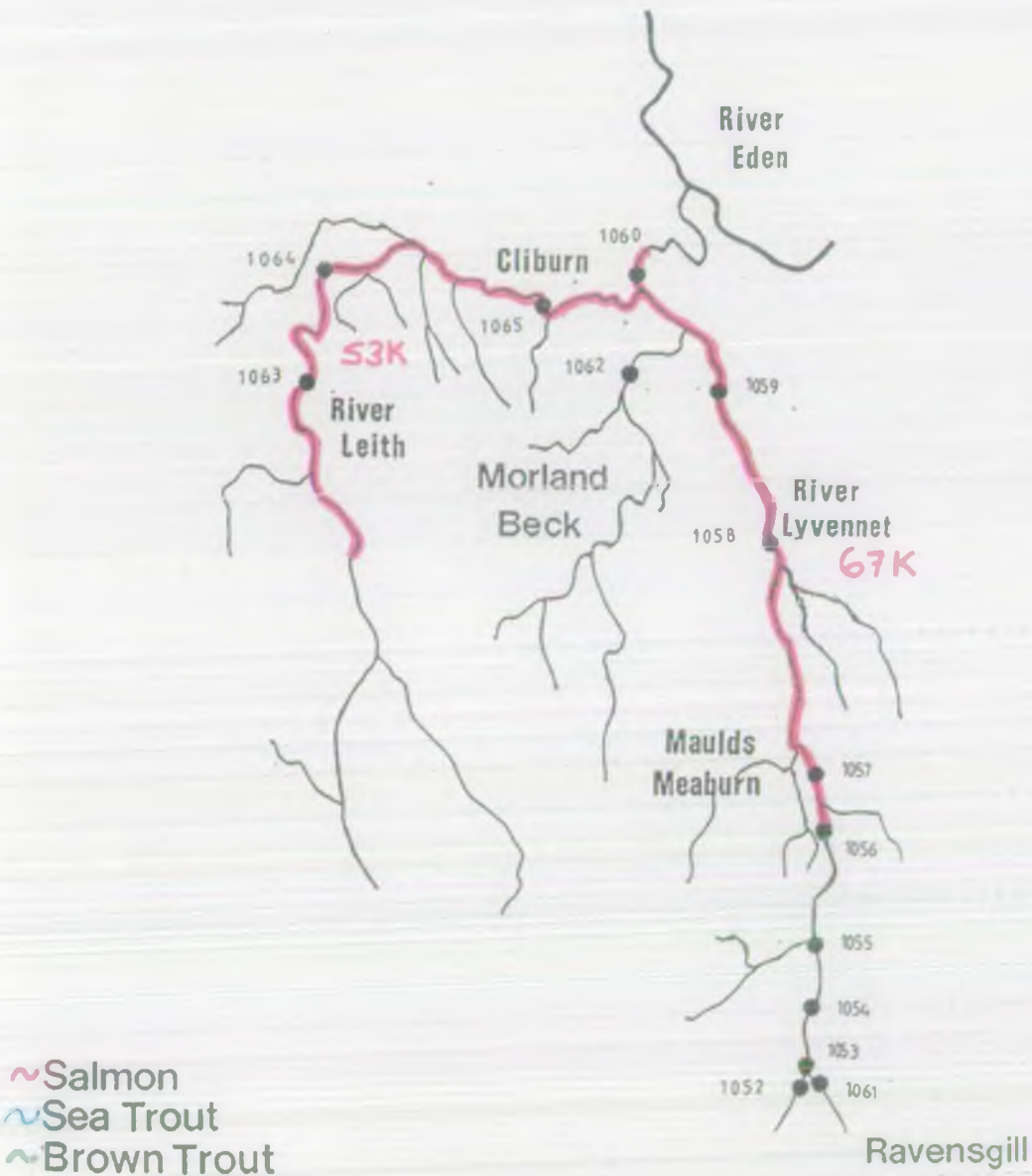
LEITH, LYVENNET CATCHMENT

Stocking Data 1991



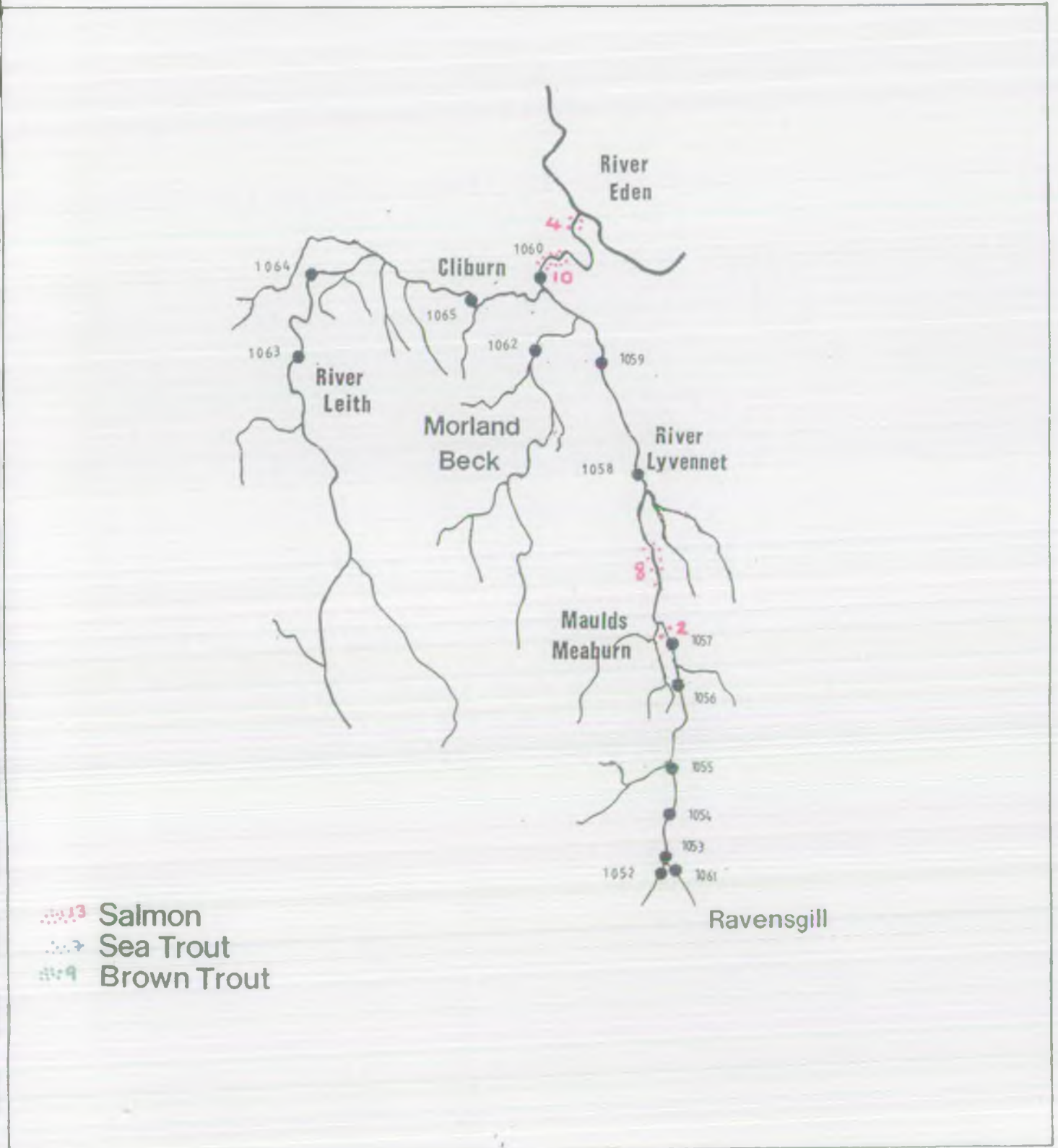
LEITH, LYVENNET CATCHMENT

Stocking Data 1992



LEITH, LYVENNET CATCHMENT

Redd Counts 1990



LEITH, LYVENNET CATCHMENT

Redd Counts 1991



- 13 Salmon
- 7 Sea Trout
- 9 Brown Trout

LEITH, LYVENNET CATCHMENT

Known Obstacles To Migratory Fish - 1992



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- Appendix 2 Derivation of Total Salmonid Density Class
- Appendix 3 Estimation of Production by Reach
- Appendix 4 Biologically Inferred Water Quality in the Upper Eden Catchment
1992
- Appendix 5 Biologically Inferred Water Quality in the Leith and Lyvennet Catchment
1992
- Appendix 6 Site Details

APPENDIX 1

CALCULATION OF ESTIMATED POPULATION DENSITIES

The relationship between densities obtained from single fishings (S.Q.) and multiple fishings (Q) was the subject of an N.R.A. Regional study - it is reported in:-

Farooqi, M. and Aprahamian M. W. 1993.

The calibration of a semi-quantitative Approach to Fish Stock Assessment in the N.W. Region of the N.R.A.

N.R.A. Internal Report: NRA/NW/FTR/93/4

A strong correlation between both methods of sampling was achieved (>80%) in all age classes for salmonids. The appropriate multipliers are shown below.

Age and Species

0+ Salmon	$Q = 2.16 \times SQ$
>0+ Salmon	$Q = 2.36 \times SQ$
0+ Trout	$Q = 1.94 \times SQ$
>0+ Trout	$Q = 1.86 \times SQ$

Where Q = the quantitative result from multiple fishings and SQ = the semi quantitative result from a single fishing.

These multipliers were used in this survey to produce an estimated population density (N/100m²).

APPENDIX 2

Derivation of Total Salmonid Density Class

In order to create a class which related to Total Salmonid Density (ie. all salmon plus all trout) it was necessary to rationalise the abundance categories for the two different age classes, ie. fry and parr (Table 1).

The classes are based on the assumption that 1 in 5, or 20%, of fry survive to become parr (Table 1). Thus, by dividing the total fry density by 5, all densities could be related to the Abundance Class for parr.

An index for Total Salmonid Density was calculated using densities as follows;

$$\text{Index} = 1/5 (\text{Salmon } 0+ + \text{Trout } 0+) + (\text{Salmon } >0+ + \text{Trout } 0+)$$

As this index was derived from both salmon and trout the parr abundance categories have been doubled (Table 3).

Table 3 Classification for Total Salmonid Density Index (N/100m²)

Class

A	>40.00
B	20.01 - 40.00
C	10.01 - 20.00
D	0.01 - 10.00
E	0.00

Thus a site scoring Class B would have a minimum of 20.01 parr per 100m² and a maximum of 40 parr per 100m² or the equivalent fry densities, or a mixture of both.

APPENDIX 3

ESTIMATION OF PRODUCTION BY REACH

Method

Each site was assigned a stream length which extended from a point midway to the next site upstream to a point midway to the next site downstream.

For the most upstream site on a reach the assigned length started 0.5km upstream of the site unless there was a waterfall or other obstruction.

The length was measured down to the confluence or another significant feature for the most downstream site on a reach.

The assigned length was then multiplied by the site width to obtain an area. This area was then multiplied by the densities of each age class to obtain numbers of fish. These numbers were then added together to give production figures for whole streams or reaches.

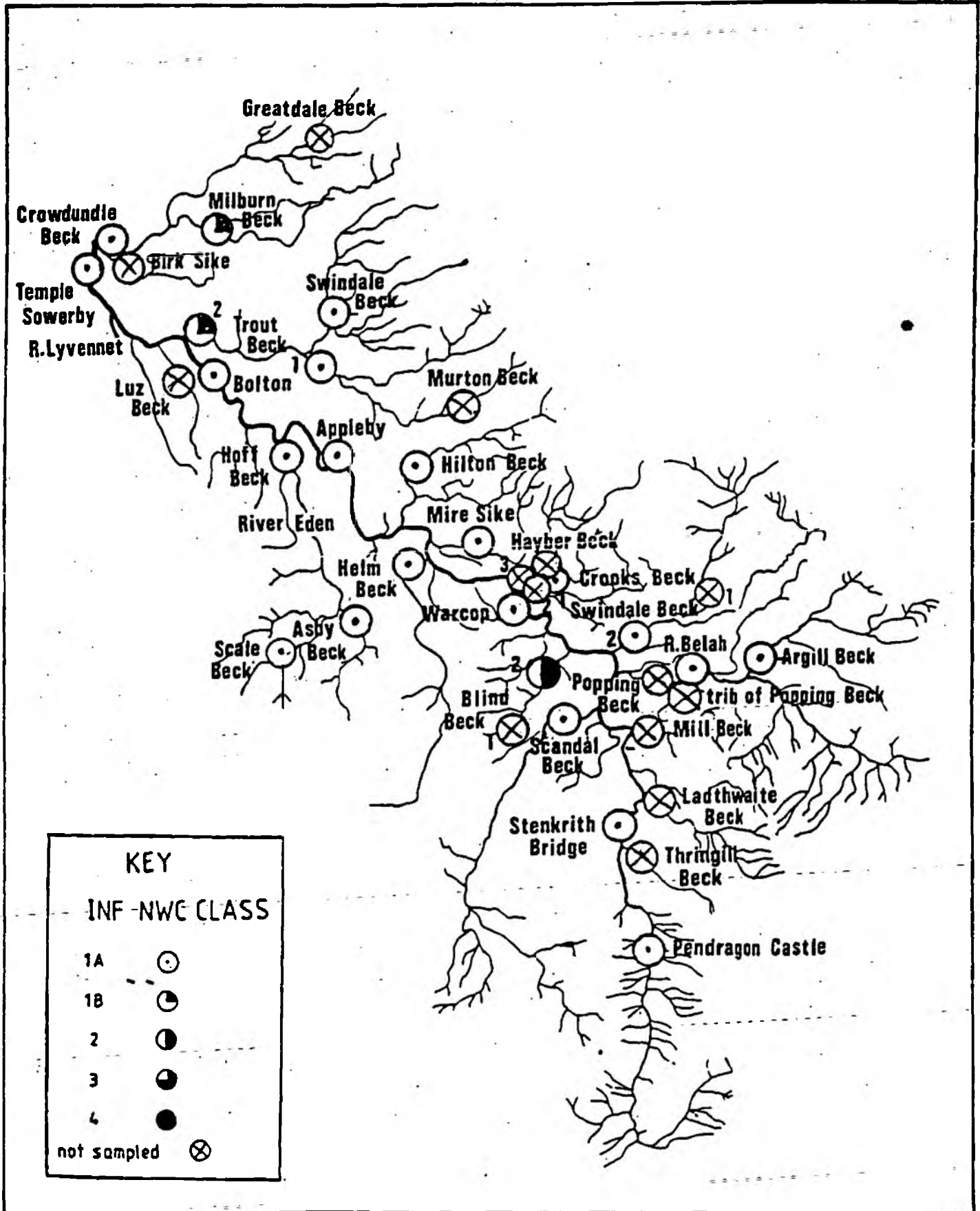
Assumptions

1. That there is no production above the 0.5km upstream of the top site of a reach (not true in most cases).
2. That the whole stream length has the same productivity as the survey sites (this is probably less true for wider streams where riffle habitats are often scarcer than on narrow streams).
3. That there is no production on unsurveyed streams. Such streams are small but could produce significant numbers in total.

UPPER EDEN CATCHMENT

BIOLOGICALLY INFERRED WATER QUALITY

Summer 1992

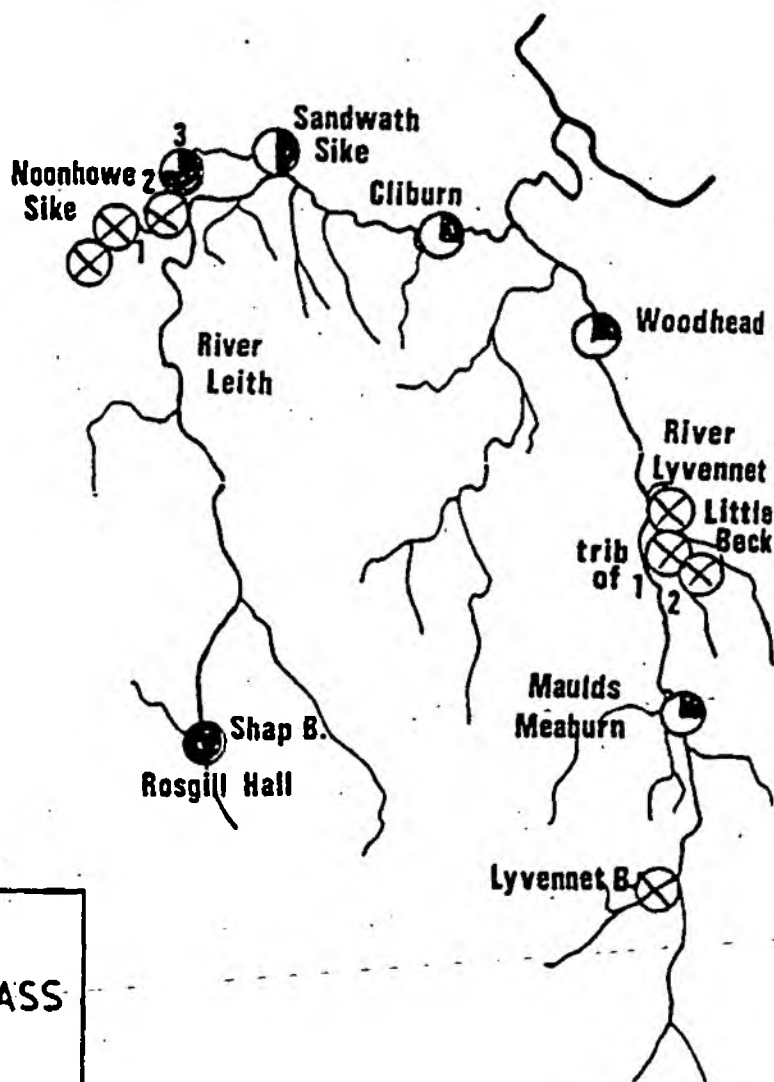


LEITH & LYVENNET CATCHMENT

APPENDIX 5

BIOLOGICALLY INFERRED WATER QUALITY

Summer 1992



KEY	
INF-NWC CLASS	
1A	○
1B	◐
2	◑
3	◒
4	◓
not sampled	⊗

SITE DETAILS: UPPER EDEN CATCHMENT

SITE No	STREAM	SITE	DATE	NGR	WIDTH (m)	LENGTH (m)	AREA (m ²)
1,001.00	RIVER EDEN	AT HANGING LUND	15/07/92	NY 778985	4.60	50	230
1,002.00	RIVER EDEN	AT HAZELGILL	06/08/92	NY 782998	6.30	58	365
1,003.00	RIVER EDEN	U/S OUTHGILL	16/09/92	NY 779012	6.25	65	406
1,004.00	RIVER EDEN	AT PENDRAGON CASTLE	16/09/92	NY 782027	8.36	51	426
1,005.00	RIVER EDEN	AT WHARTON HALL	06/08/92	NY 773058	7.40	58	429
1,006.00	RIVER EDEN	IN KIRKBY STEPHEN	16/09/92	NY 776089	14.30	46	658
1,007.00	RIVER EDEN	KIRKBY STEPHEN	21/07/92	NY 774102	9.00	50	450
1,009.00	RIVER EDEN	WARCOP	21/07/92	NY 774150	24.40	55	1,342
1,010.00	RIVER EDEN	U/S SANDFORD	21/07/92	NY 735159	13.10	50	655
1,011.00	RIVER EDEN	AT GREAT ORMSIDE	21/07/92	NY 698178	25.40	50	1,270
1,012.00	RIVER EDEN	AT APPELBY	21/07/92	NY 683206	24.80	60	1,488
1,013.00	RIVER EDEN	AT BROCKHAM	30/06/92	NY 651223	23.40	50	1,170
1,014.00	RIVER EDEN	AT BOLTON	30/06/92	NY 642235	20.10	64	1,270
1,015.00	RIVER EDEN	OUSEN STAND	30/06/92	NY 614253	23.10	73	1,686
1,016.00	RIVER EDEN	AT TEMPLE SOWERBY	30/06/92	NY 605275	26.00	70	1,820
1,017.00	SCANDAL BECK	U/S RAVENSTONEDALE	28/07/92	NY 727037	3.30	50	165
1,018.00	SCANDAL BECK	D/S RAVENSTONEDALE	28/07/92	NY 722046	4.70	50	235
1,019.00	SCANDAL BECK	AT SMARDALE	28/07/92	NY 735085	9.10	50	455
1,020.00	SCANDAL BECK	IN SOULBY	06/08/92	NY 749109	7.30	62	453
1,022.00	RIVER BELAH	AT FIELD HEAD	06/10/92	NY 818122	11.00	50	550
1,023.00	RIVER BELAH	AT BROUGH SOWERBY	26/08/92	NY 794121	9.48	45	427
1,024.00	RIVER BELAH	AT MERRICKS	06/08/92	NY 773124	7.50	53	398
1,026.00	ARGILL BECK	AT ARGILL HOUSE	25/08/92	NY 825127	5.40	50	270
1,026.10	ARGILL BECK	D/S ARGILL HOUSE	25/08/92	NY 824127	6.71	50	336
1,027.00	SWINDALE BECK	U/S BROUGH	27/09/92	NY 797147	4.53	38	172
1,028.00	SWINDALE BECK	AT HALL GARTH	16/09/92	NY 775136	9.03	57	515
1,029.00	AUGILL BECK	U/S A66	25/08/92	NY 817147	2.00	50	100
1,030.00	AUGILL BECK	AT CHURCH BROUGH	06/08/92	NY 797141	2.70	61	165
1,031.00	CROOKS/HAYBER BECK	AT WARCOP	27/08/92	NY 751156	3.90	50	195
1,032.00	HELM BECK	AT GRIZEBURN	18/08/92	NY 713123	3.60	42	151
1,033.00	HELM BECK	AT HELM BECK COTTAGE	18/08/92	NY 709149	5.00	45	225
1,034.00	HELM BECK	AT LITTLE ORMSIDE	18/08/92	NY 702165	6.80	62	422
1,035.00	HILTON BECK	IN HILTON	10/08/92	NY 732208	4.20	54	227
1,036.00	HILTON BECK	NEAR STONERIGGS	10/08/92	NY 720207	4.10	50	205
1,037.00	HILTON/COUPLAND BECK	D/S RAILWAY VIADUCT	10/08/92	NY 705185	5.30	58	307
1,038.00	ASBY BECK	D/S GREAT ASBY	18/08/92	NY 685137	4.00	64	256
1,039.00	ASBY BECK	NEAR BOWBRIDGE HOUSE	27/09/92	NY 685150	4.96	47	233
1,040.00	HOFF BECK	D/S RUTTER FORCE	18/08/92	NY 682158	9.60	52	499
1,041.00	HOFF BECK	AT HOFF	18/08/92	NY 675175	7.49	51	382
1,041.00	HOFF BECK	AT HOFF	18/08/92	NY 675175	7.50	51	383
1,042.00	HOFF BECK	U/S BANDLEY BR	16/09/92	NY 672189	10.38	72	747
1,042.00	HOFF BECK	U/S BANDLEY BR	16/09/92	NY 672189	10.40	72	749
1,043.00	HOFF BECK	AT COLBY HALL	17/08/92	NY 665209	8.13	58	472
1,043.00	HOFF BECK	AT COLBY HALL	17/08/92	NY 665209	8.70	58	505
1,044.00	SCALE BECK	AT SCALE BECK FARM	18/08/92	NY 673144	3.40	50	170
1,046.00	TROUT/BRAMPTON BECK	FLAKEBRIDGE WOOD	27/08/92	NY 692232	4.90	45	221
1,046.10	TROUT/BRAMPTON BECK	FLAKEBRIDGE FARM	10/08/92	NY 692232	3.90	50	195
1,047.00	TROUT/BRAMPTON BECK	NEAR BRAMPTON	10/08/92	NY 685234	4.40	50	220
1,048.00	TROUT BECK	AT BROAD LEA	05/08/92	NY 659241	5.80	45	261
1,049.00	TROUT BECK	NEAR SLEASTONHOW	10/08/92	NY 646245	6.20	50	310
1,050.00	TROUT BECK	AT KIRKBY THORE	05/08/92	NY 635252	6.20	56	347
1,051.00	SWINDALE BECK	AT DUFTON	17/08/92	NY 685253	3.50	55	193
1,052.00	RIVER LYVENNET	CROSBY LODGE FARM	27/07/92	NY 621126	5.00	56	280
1,053.00	RIVER LYVENNET	CROSBY LODGE FARM	27/07/92	NY 622128	3.60	50	180
1,054.00	RIVER LYVENNET	WOODFOOT BRIDGE	27/07/92	NY 623137	2.90	56	162
1,055.00	RIVER LYVENNET	CROSBY RAVENSWORTH	20/07/92	NY 624148	5.80	47	273
1,056.00	RIVER LYVENNET	IN MAULDS MEABURN	20/07/92	NY 626164	7.80	48	374
1,056.00	RIVER LYVENNET	IN MAULDS MEABURN	20/07/92	NY 626164	7.80	483	3,767
1,057.00	RIVER LYVENNET	AT MEABURN HALL	20/07/92	NY 624172	8.80	55	484
1,057.00	RIVER LYVENNET	AT MEABURN HALL	20/07/92	NY 624172	8.80	55	484
1,058.00	RIVER LYVENNET	AT KINGS MEABURN	20/07/92	NY 618213	6.30	41	258
1,059.00	RIVER LYVENNET	AT WOODHEAD	20/07/92	NY 613231	7.20	50	360
1,059.00	RIVER LYVENNET	AT WOODHEAD	20/07/92	NY 613231	7.20	50	360
1,060.00	RIVER LYVENNET	AT BRIGHAM BANK	20/07/92	NY 600248	9.50	77	732
1,060.00	RIVER LYVENNET	AT BRIGHAM BANK	20/07/92	NY 600248	9.50	77	732
1,061.00	RAVENS GILL	U/S LYVENNET	27/07/92	NY 623126	2.40	53	127
1,062.00	MORLAND BECK	AT GLENTON VALE	17/08/92	NY 598231	3.40	52	177
1,063.00	RIVER LEITH	AT GREAT STRICKLAND	28/07/92	NY 551227	5.30	57	302
1,063.00	RIVER LEITH	AT GREAT STRICKLAND	28/07/92	NY 551227	5.69	51	290
1,064.00	RIVER LEITH	AT MELKINTHORPE	27/07/92	NY 556250	7.10	52	369
1,064.00	RIVER LEITH	AT MELKINTHORPE	27/07/92	NY 556250	7.10	52	369
1,065.00	RIVER LEITH	AT CLIBURN	27/07/92	NY 588244	5.30	54	286
1,065.00	RIVER LEITH	AT CLIBURN	27/07/92	NY 588244	10.04	54	289
1,066.00	CROWDUNDE BECK	NEAR UNDERWOOD	05/08/92	NY 645305	5.00	43	215
1,067.00	CROWDUNDE BECK	U/S MILBURN BECK	05/08/92	NY 630291	6.70	46	308
1,068.00	CROWDUNDE BECK	IN NEWBIGGIN	03/08/92	NY 627287	6.70	50	335
1,069.00	CROWDUNDE BECK	AT MILLRIGG BRIDGE	03/08/92	NY 609281	6.20	75	465
1,070.00	MILBURN BECK	AT GULLOM HOLME	05/08/92	NY 656285	5.10	57	291
1,071.00	MILBURN BECK	U/S CROWDUNDE BECK	05/08/92	NY 631290	5.80	53	307