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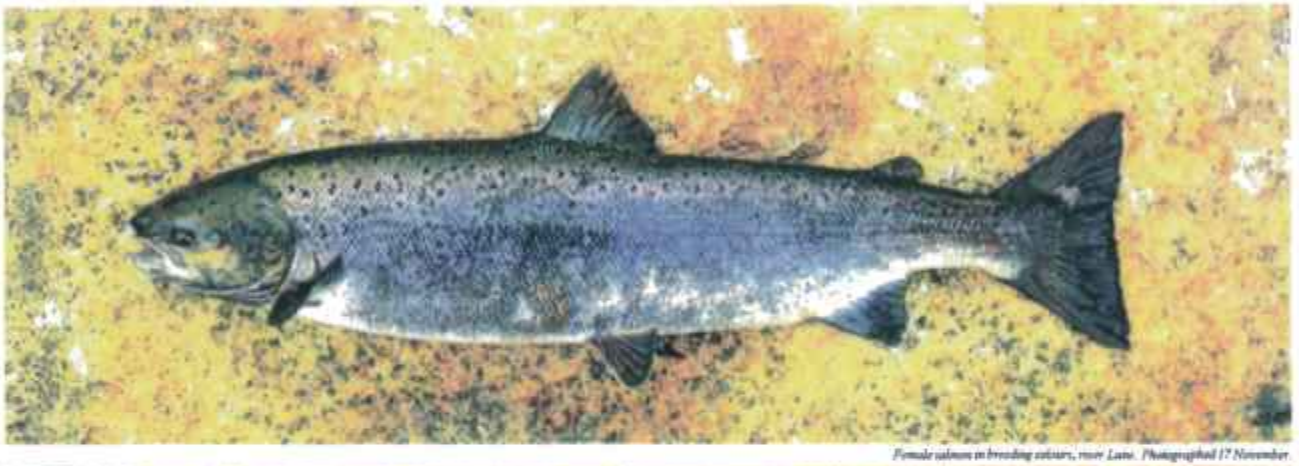
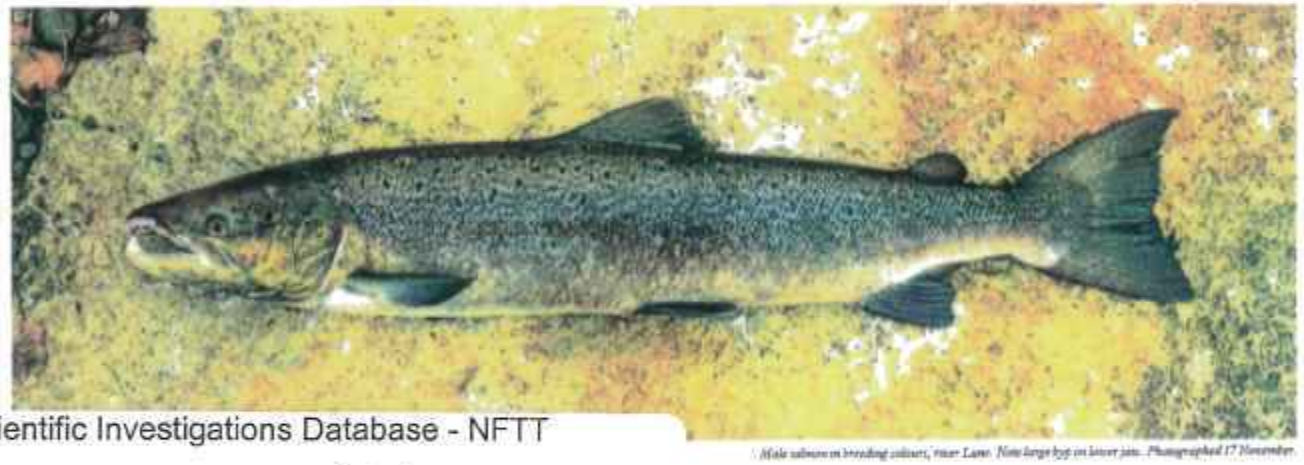
# The Juvenile Salmonid Populations Of The River Lune Catchment, 1981 To 1985



Female salmon in breeding colours, river Lune. Photographed 17 November



Male salmon in breeding colours, river Lune. Note large hyp on lower jaw. Photographed 17 November



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April 1993

# The Juvenile Salmonid Populations Of The River Lune Catchment, 1981 To 1985



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## Summary

1. The distribution and abundance of juvenile salmon was found to be relatively consistent in each of the 13 subcatchments studied over the 1981-1985 period. In terms of density the most productive areas were the upper Lune and its tributaries (subcatchment 1), Birk Beck/Borrowdale Beck (subcatchment 5), Chapel Beck/Croasdale Beck (subcatchment 6), and Barbon Beck/Leck Beck (subcatchment 10).

2. 0+ salmon year class strength was highest in 1982 and 1983 when 37% and 38% respectively of the sites sampled were in the highest density categories of class A, B, and C. It is considered that the 1981 results for fry were under estimates of the population because greater emphasis was placed on the capture of parr during that survey. The strong 0+ year classes of 1982 and 1983 are reflected in the results for 1+ salmon with good year classes being produced in 1983 and 1984 (33% and 54% of sites sampled were in categories A, B, C).

3. Certain areas of the catchment were relatively unproductive for juvenile salmon namely the Greta (subcatchment 11) Wenning (subcatchment 12), and Hindburn/Roeburn (subcatchment 13). A combination of the following factors are thought to play a major role in this respect:

   (a) The presence of instream obstructions likely to affect adult salmon migration.

   (b) The availability of suitable habitat for spawning.

   (c) Interspecific competition between salmon and trout in areas such as Austwick Beck (site 150, 151, and 151b), Clapham Beck (site 148) and the Roeburn (site 157 and 158).

4. Juvenile trout were found to be widely distributed in the Lune catchment although the majority of sites sampled were placed in the lowest density categories (class D and E). Regression analysis revealed that trout densities were significantly inversely correlated with stream width. This may be a habitat and flow related phenomenon with trout tending to occupy the margins. 28% to 48% of the variation in 0+ trout densities could be explained by stream width and for 1+ trout this was found to be 22% to 37%. In practical terms this means that in large streams a considerable proportion of the area fished (using standard survey methodology) was not suitable trout habitat and will not give a true reflection of the status of trout production.

5. In many instances there was circumstantial evidence to suggest a correlation between stocked areas and the post stocking densities of salmon fry and parr indicating some degree of success for the enhancement stocking programme.

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# The Juvenile Salmonid Populations Of The River Lune Catchment, 1981 To 1985

## 1. Introduction

The aim of this study was to assess the status of the juvenile salmonid populations of the River Lune and its tributaries.

There was special emphasis on juvenile salmon stocks in view of the implementation of a net limitation order in 1980. The number of licensed instruments were reduced as follows:

(1) Drift, hang or whammel nets - from 12 to 10
(2) Draft or seine nets - from 3 to 1
(3) Heave or haaf nets - from 46 to 26

For the purpose of this report, the River Lune system has been divided into 13 subcatchments and these are examined with a view to detecting any trends in the data such as subcatchment productivity, partitioning between salmon and trout nursery streams, and whether the restrictions on salmon fishing had any discernible effects on juvenile salmon productivity. The effect of flow and instream obstructions on salmonid densities are also investigated as these have been shown to be important factors affecting abundance (Elliott, 1984; Gardiner, 1989).

Throughout the study period a programme of enhancement stocking took place primarily with salmon ova and fry. The possible impact of this on the results of the surveys has been assessed.

Some reference will be made to the results of the 1991 River Lune strategic survey (Farooqi and Aprahamian, 1992) for comparative purposes.

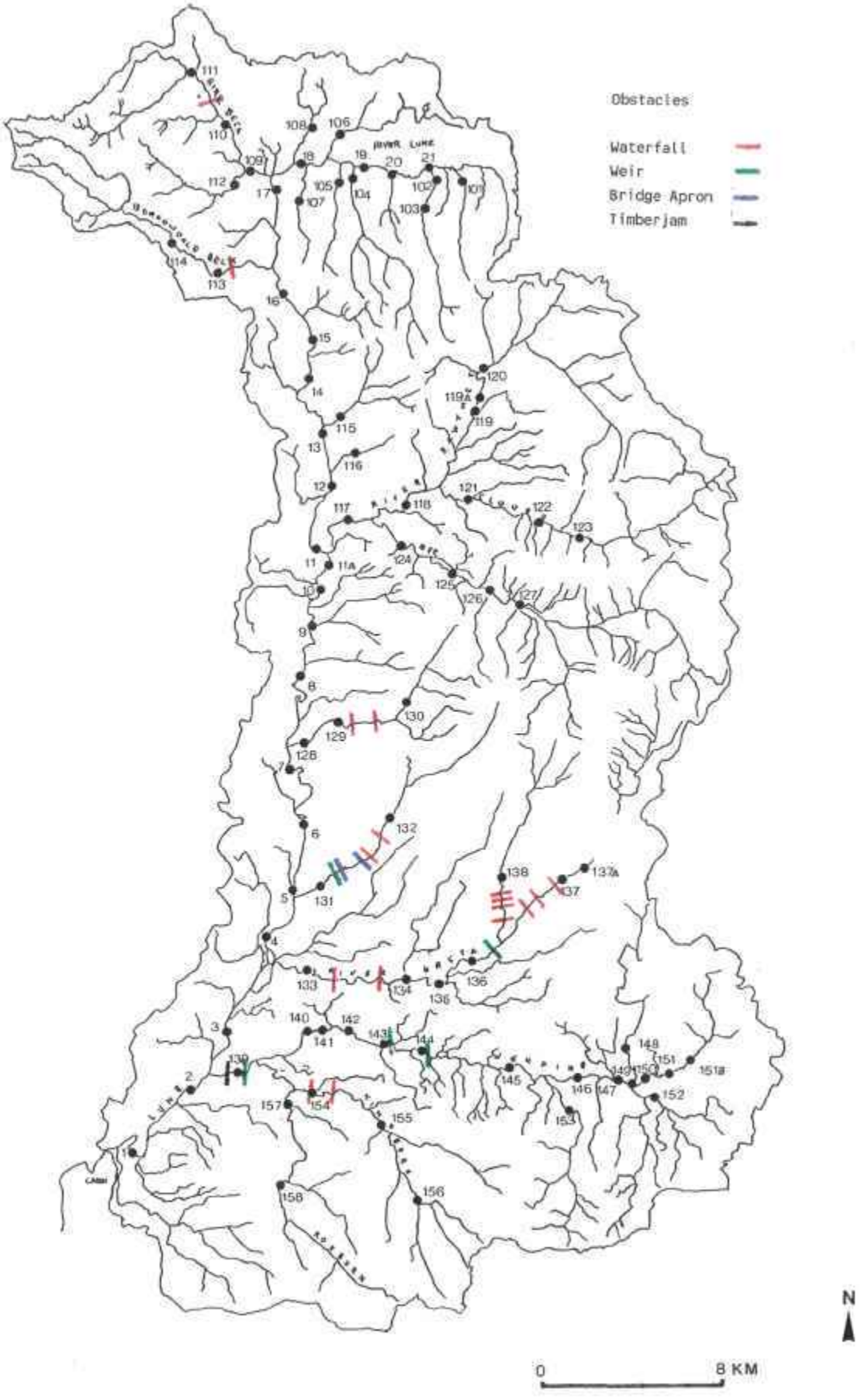
## 2. Description of the study area

The study area and distribution of sampling sites is shown in Fig. 1. The area was divided into 13 subcatchments the details of which are shown in Appendix 1 together with the grid reference and dimensions of each site.

The River Lune descends from an altitude of 540m (N.G.R. NY 702013) and runs for approximately 87km before entering the sea at Morecambe Bay. The catchment covers an area of approximately 1223km$^2$. The land is used primarily as pasture for cattle and sheep, and also for hay and silage production.

Three distinct geological features are evident. The upper reaches of the Lune (subcatchment 1), Birk Beck (subcatchment 5), the Clough (subcatchment 8), and upper reaches of the Dee (subcatchment 9) flow over a Carboniferous limestone series (alternating limestones, sandstones and mudstones). The Lune and minor tributaries from site 7 to 17, together with

Fig. 1 Sampling Sites And Known Obstacles To Migratory Fish In The River Lune Catchment



Borrowdale Beck (subcatchment 5), the Rawthey (subcatchment 7) and lower section of the Dee flow over Silurian slates, grits and flags (hard, inert and impermeable). The underlying geology of the lower Lune (sites 1 to 5) and minor tributaries, together with the Greta (subcatchment 11, excluding site 137 and 138), tributaries of the upper Wenning (subcatchment 12), the Hindburn and the Roeburn (subcatchment 13) is of a Carboniferous millstone grit series (alternating shales, mudstones and sandstones). There is some base flow from the sandstones.

Obstacles to migratory salmonids such as weirs can be an important factor affecting the distribution and abundance of their offspring. Fig. 1 shows some of the known barriers to fish movement in relation to the survey sites (J. Staveley, J. Burton, and A. Atkinson pers. comm.). The waterfall on Birk Beck (downstream of site 111) and the one on Barbon Beck (downstream of site 130) are impassable to migratory fish.

Water quality data was available for the summer of 1984 and late summer 1985 and refers to 7 sampling points along the length of the river (Wath, site 21; Tebay, site 17; Killington, site 10; Rigmaden, site 8; Kirkby Lonsdale, site 6; Gressingham site 3; and downstream of Forge Weir, site 1). These all had an inferred NWC classification of 1A which is indicative of excellent water quality (B. Ingersent pers. comm.).

More recent water quality surveys have shown that this standard has been maintained. The 1991 biology survey of the river Lune catchment which was completed on 30/07/91 (Saxby, 1991) concluded that the catchment was predominantly clean and productive.

## 3. Methods

The number of sites sampled varied between years. The initial survey in 1981 consisted of 51 sites which was followed by 79, 77, 76, and 76 in the subsequent years leading up to 1985.

All sites were sampled by successive removal of fish between stop nets using electrofishing apparatus during the summer months of 1981-1985. The number and length (measured as fork length to the nearest cm below) of each fish was recorded and by examining the length frequency distribution it was possible to separate the juvenile fish into 0+ and > 0+ age classes.

Quantitative estimates of fish populations were calculated for each age group by the Carle and Strub (1978) method and these were expressed as numbers per $100m^2$ with 95% confidence limits. If the overall probability of capture was greater than or equal to 0.3 and was constant between fishings (as indicated by chi squared analysis) then the population estimate was considered to be valid. When this was not the case then a minimum estimate of the population was calculated ((number of fish/total area) x 100).

A mean population density was derived for each site sampled during the period 1981 to 1985. This mean density was calculated as the sum of the population estimates of a given site divided by the sum of the total area fished at that site over the period 1981 to 1985. In addition, each site was classified according to the density of fish recorded. The classification system used was developed for the rivers of the North West Region and is shown in Table 1, ranging from class A to class E in order of decreasing density.

The coefficient of variation (CV) is a measure of relative dispersion about the mean and this was calculated for the mean density of each site over the 1981 to 1985 period to give an indication of the variability of juvenile salmonid production at that site.

$$CV = S\ (100/X)$$

where

X = sample mean
S = standard deviation of sample

Minimum population estimates were not used in the calculation of mean site density and coefficient of variance since there is no variance associated with these estimates.

To detect natural groupings that may be present in the data set a multivariate statistical technique (Cluster Analysis) was employed using the statistical package 'Systat' (Wilkinson, 1990). The intention was to use cluster analysis as an exploratory tool. The analysis was extended to include 0+ and 1+ densities of salmon and trout over the period 1981-1985 and to examine the interaction between age classes, and between species at the same site.

The K-means splitting method was used to produce exclusive partitioned clusters. K-means searches for the best way to divide data into different groups so that they are separated as well as possible. Not all values of K lead to "natural" clusterings, but by running the program several times with different values of K, the value of K which gives rise to the most meaningful interpretations can be selected. In this respect a certain degree of subjectivity is involved.

The program works by selecting "seed" records, one for each cluster, which are spread apart from the centre of all the records as much as possible. Then it assigns all records to the nearest seed. Next it attempts to reassign each record to a different cluster in order to reduce the within-group sum of squares. K-means continues to reassign records until the within group sum of squares can no longer be reduced.

K-means uses Euclidean distance for its clustering metric. Missing data are excluded from distance calculations by pairwise deletion. Minimum densities were excluded from the analysis.

Table 1 Abundance categories (n/100m$^2$) for juvenile salmon and trout for rivers of the North West region of the NRA

| Quantitative | | |
|---|---|---|
| | Fry (0+) | Parr (>0+) |
| Class A | >100.00 | >20.00 |
| Class B | 50.01-100.00 | 10.01-20.00 |
| Class C | 25.01- 50.00 | 5.01-10.00 |
| Class D | 0.01- 25.00 | 0.01- 5.00 |
| Class E | 0.00 | 0.00 |

| Semi-quantitative | | |
|---|---|---|
| | Fry (0+) | Parr (>0+) |
| Class A | >50.00 | >15.00 |
| Class B | 22.51-50.00 | 7.51-15.00 |
| Class C | 10.01-22.50 | 2.51- 7.50 |
| Class D | 0.01-10.00 | 0.01- 2.50 |
| Class E | 0.00 | 0.00 |

The relationship between the abundance of a year class in a particular year and its abundance in the subsequent year was examined by regression analysis using the statistical package Minitab (Ryan et al., 1985). Minimum estimates were excluded from the analysis. A $\log_e$ transformation was used on the data.

Regression analysis was performed to investigate whether a relationship exists between stream width and juvenile salmonid density. A $\log_e$ transformation was applied to the data. Also examined by regression analysis was the relationship between salmon and trout densities.

Flow data (monthly mean in cumecs) was only available from the Caton gauging station on the Lune (near site 1). For each month of the 1982-1985 period flow data was ranked with the highest measurement being classed as 1 and the lowest 4. Salmonid densities were similarly ranked for each site over the 1982-1985 period and the Pearson product moment correlation coefficient calculated using Minitab.

## 4. Results

### 4.1 0+ and 1+ Salmon Densities 1981-1985

#### 4.1.1 0+ Salmon 1981

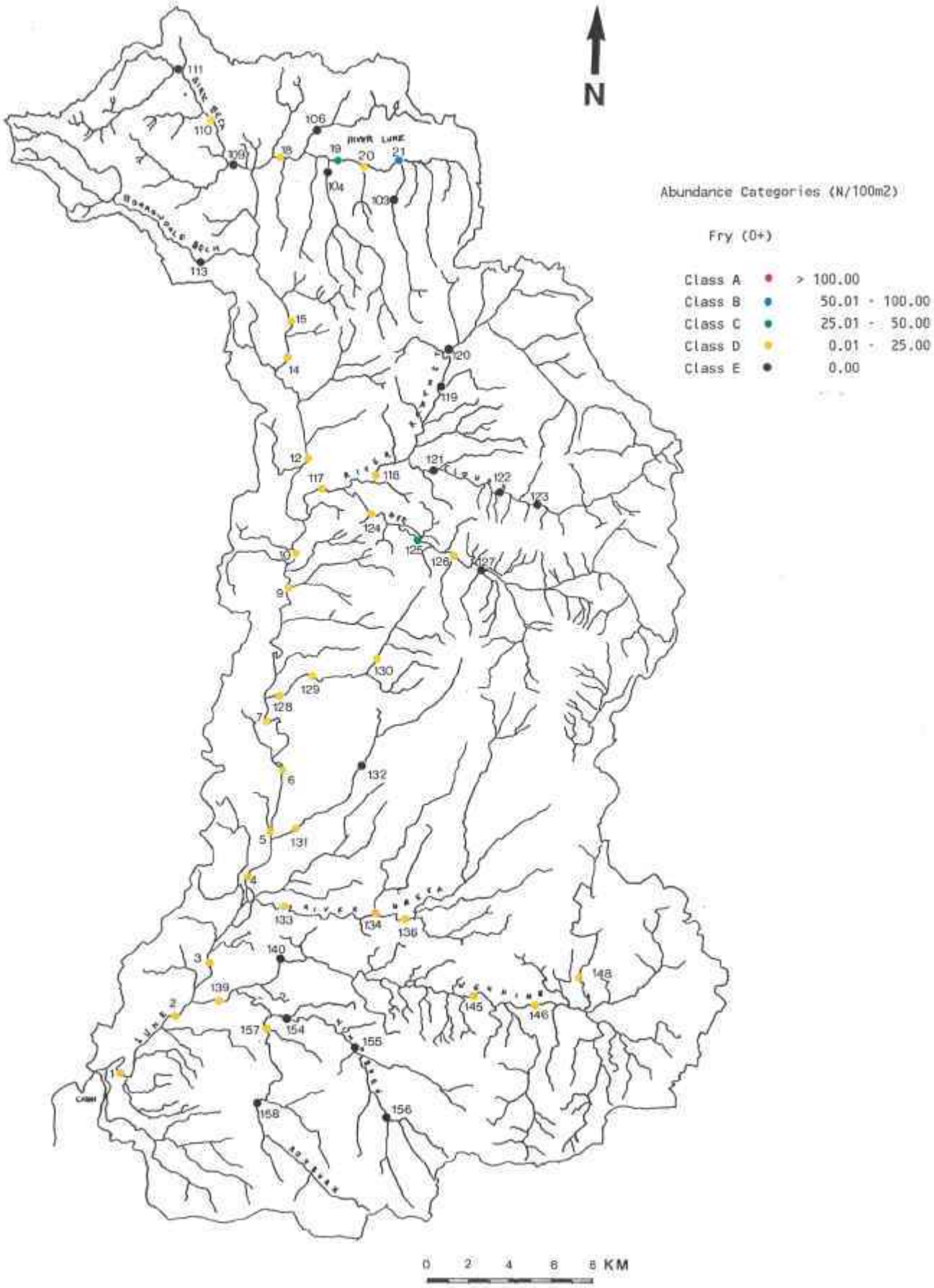
The results suggest that fry production in 1981 was very limited throughout the catchment (Fig. 2). However, this must be seen in the context of the main objective of the 1981 survey which was to quantify salmon parr densities in the Lune catchment. As a consequence fry densities were considered to be under represented.

60.78% of the sites sampled were categorised as class D and 33% as class E (Fig. 3). The Clough (sites 121, 122, 123) and the majority of the Hindburn/Roeburn (sites 154, 155, 156, 158) system fell into the class E category. There were only 3 sites which had densities greater than 25/100$m^2$ and these were Dee 125 (class C), Lune 19 (class C) and Lune 21 (class B).

286,648 salmon fry and 40,216 eyed ova were stocked in the Lune catchment in 1981. Some of the sites sampled in the 1981 juvenile salmonid survey were in the vicinity of the stocked areas. These sites included the Lune at Fleetholme (site 14) where 10,015 fry were stocked, Fairmile (site 15) with 10,015, Lincoln Inn (site 12) with 4,000, Old Tebay Bridge (site 18) with 10,138, Barbon Beck (site 130) with 15,766 and Rais Beck (site 106) with 6,000 fry. The recorded densities at these sites were class D/E in line with the overall status of the catchment.

There were however 2 sites in the catchment where the observed densities may well have been influenced by the stocking programme. 10,138 fry were planted in the vicinity of Rayne

Fig. 2 0+ Salmon Densities In The River Lune Catchment 1981



Bridge (site 19) and a density of 49.7+/-12.4/100m$^2$ (class C) was recorded during the survey. A similar amount was planted in the vicinity of Wath (site 21). This site was the most productive of the sites sampled with a density of 64.7+/-3.9/100m$^2$ (class B).

### 4.1.2 1+ Salmon 1981

From Fig. 3 it can be seen that 41.18% of the sites sampled were class D, 21.57% class C, 15.69% class E, 15.67% class B and 5.88% class A.

The Barbon Beck/Leck Beck system (subcatchment 10, 20% class A, 40% class B, 40% class C, n=5), upper Lune and its tributaries (subcatchment 1, 14.3% Class A, 28.6% class B, 28.6% class C, 28.6% class D, n=7), and the Rawthey (subcatchment 7, 25% each for class A, B, C, D, n=4) were the most productive subcatchments of the Lune system (Fig. 4).

The Lune itself was found to be a relatively unproductive region. The majority of main river sites were class D (75%, n=16).

The Wenning (subcatchment 12) and Hindburn/Roeburn (subcatchment 13) systems stood out as being generally unproductive for salmon. 80% of the Wenning sites were class D and 20% class E (n=5), while 80% of the Hindburn/Roeburn sites were class E and 20% class D (N=5). These results are identical to those obtained for 0+ salmon at these sites in 1981.

338,000 salmon fry and 498,000 eyed ova were stocked in the catchment in 1980. There appeared to be a correlation between stocked areas and 1+ salmon densities at some of the survey sites which were adjacent to or in the stocked zones. 40,000 eyed ova were stocked in the vicinity of site 113 (Borrowdale Beck) in 1980 and the density of parr at this site in 1981 was found to be class B. Bowderdale Beck (103) was also stocked with 40,000 eyed ova in 1980 and this may well have contributed to the excellent parr densities recorded there (class A).

The Rayne Bridge site (19) of the upper Lune yielded a good density of parr (class B) which may have been as a result of the development of 10,000 salmon fry that were stocked in 1980.

Excellent densities were recorded at site 130 on Barbon Beck (class A) and since access for adult salmon to this site is prevented by two waterfalls (Fig. 1) the observed densities must have been due to the stocking of 30,000 fry over a 3.2km section incorporating site 130.

In other areas of the catchment the relationship between some of the stocked areas and survey sites in the vicinity of these areas was less clear e.g. Wath (site 21) and Old Tebay Bridge (site 18), both class D, possibly due to the distance between

FIG. 3 DENSITY CHARACTERISTICS
0+ SALMON

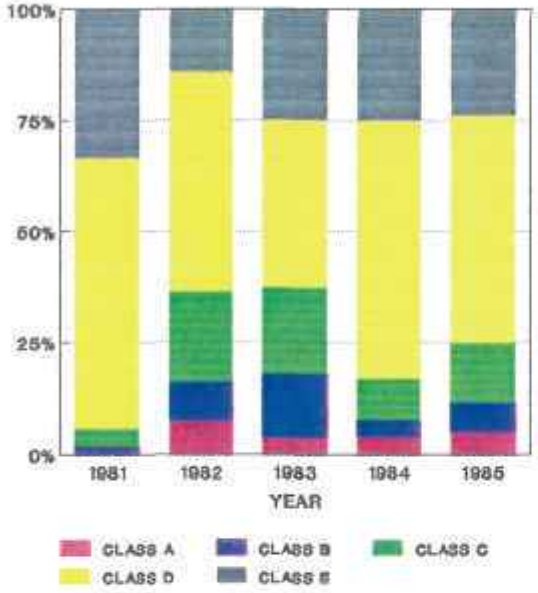



FIG. 3 DENSITY CHARACTERISTICS
1+ SALMON

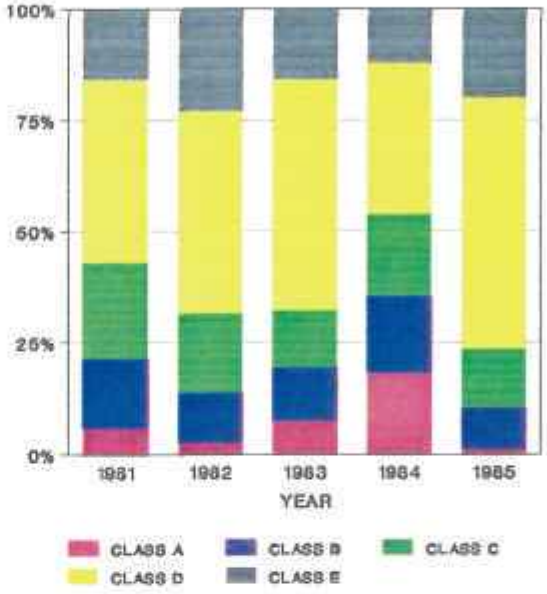



FIG. 3 DENSITY CHARACTERISTICS
0+ TROUT

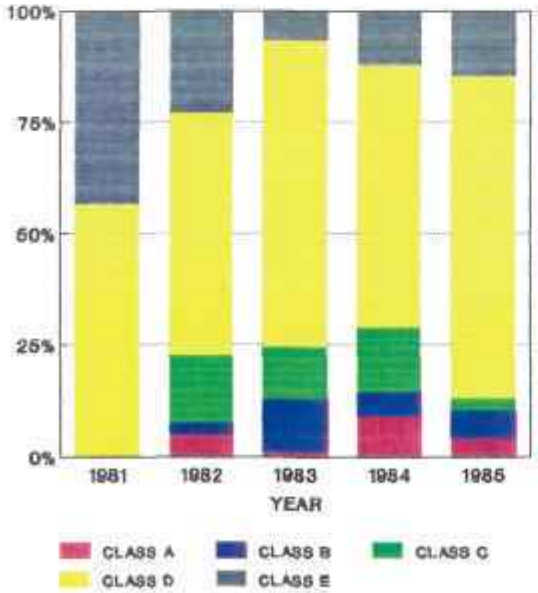



FIG. 3 DENSITY CHARACTERISTICS
1+ TROUT

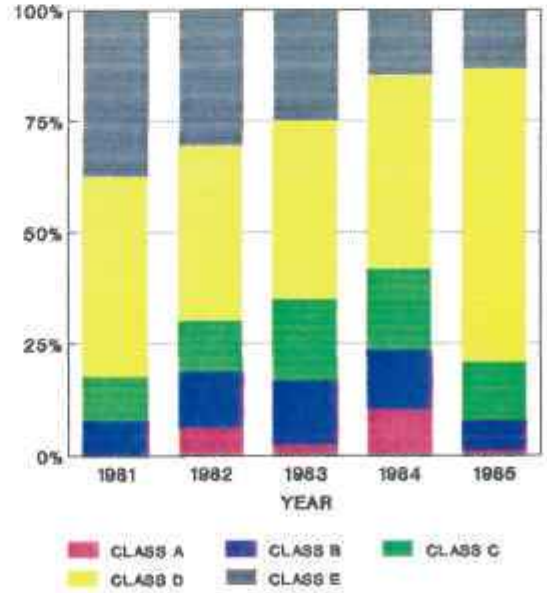
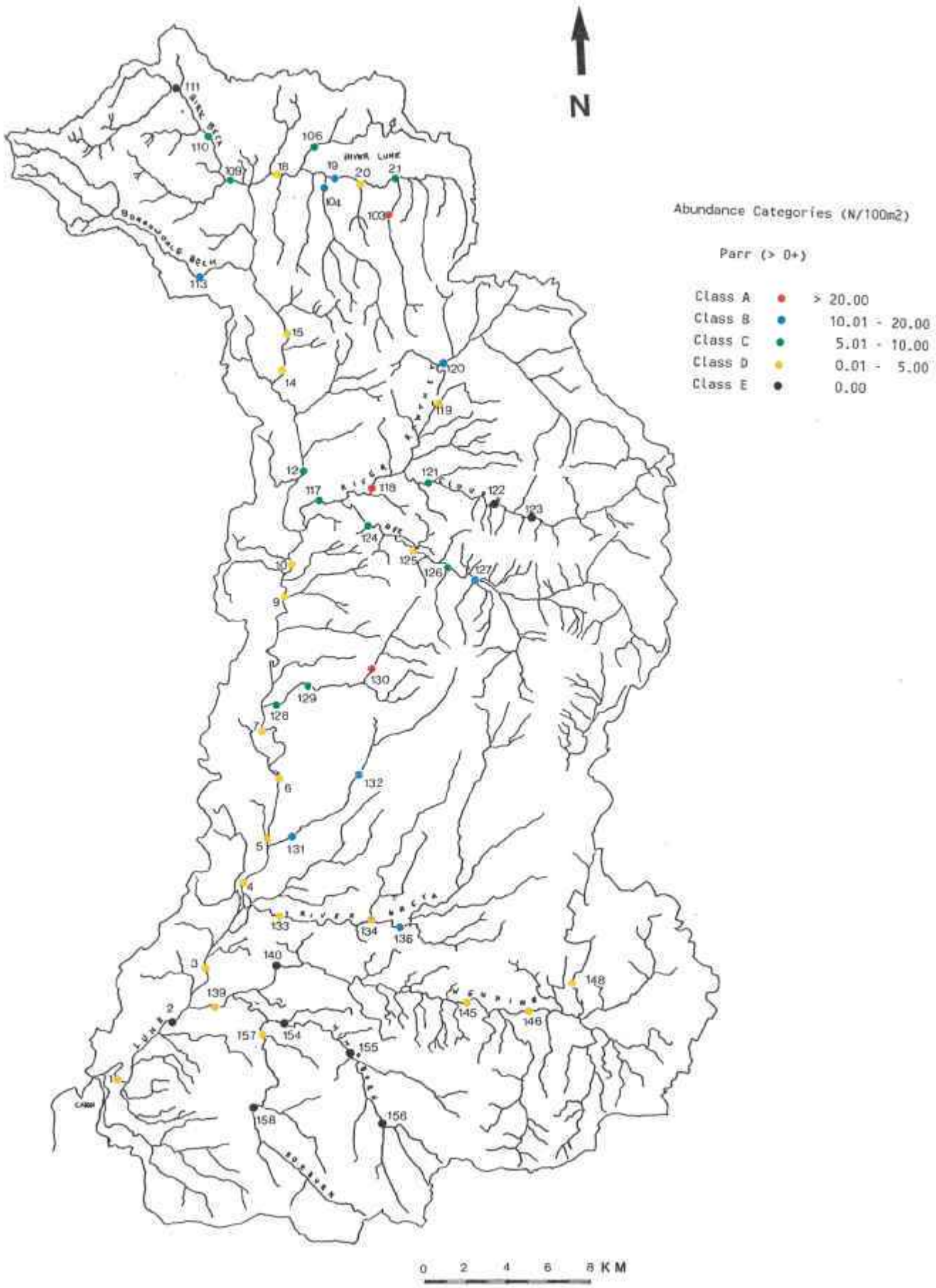


Fig. 4 1+ Salmon Densities In The River Lune Catchment 1981



the stocked areas and survey sites being to great, or little movement of fish out of the stocked zone.

### 4.1.3 0+ Salmon 1982

During the 1982 survey equal fishing effort was applied to all age classes and this could explain the marked improvement in the 0+ abundance characteristics of the catchment when compared to the 1981 results where greater emphasis was placed on the capture of parr (Figs. 3 and 5). Other factors may have also contributed for example the number of sites sampled during the survey had increased in number from 51 in 1981 to 79 in 1982. However, the observed improvement in the abundance characteristics of the catchment cannot be explained by the addition of these extra sites as these were found to be low density sites. In contrast many of the sites originally sampled in 1981 had higher densities in 1982. Enhancement stocking or the production of a strong year class or a combination of these factors may have also been involved.

In subcatchment 1 there seemed to be a certain degree of differentiation between densities at the main river sites and the tributaries of the upper Lune. All the main river sites upstream of site 17 were class B (n=4), however the associated tributary sites of the subcatchment ranged from class C to E (n=8).

The main river sites up to site 16 were predominantly class D (75%), but there was a noticeable improvement in densities between sites 4 to 7. Site 6 being class A and the rest class C.

Of the Birk Beck/Borrowdale Beck system the latter was the most productive (site 113 class A, and site 114 class B, n=2) while on Birk Beck the three main beck sites (109 to 111) were all class D and the tributary site (112) class B.

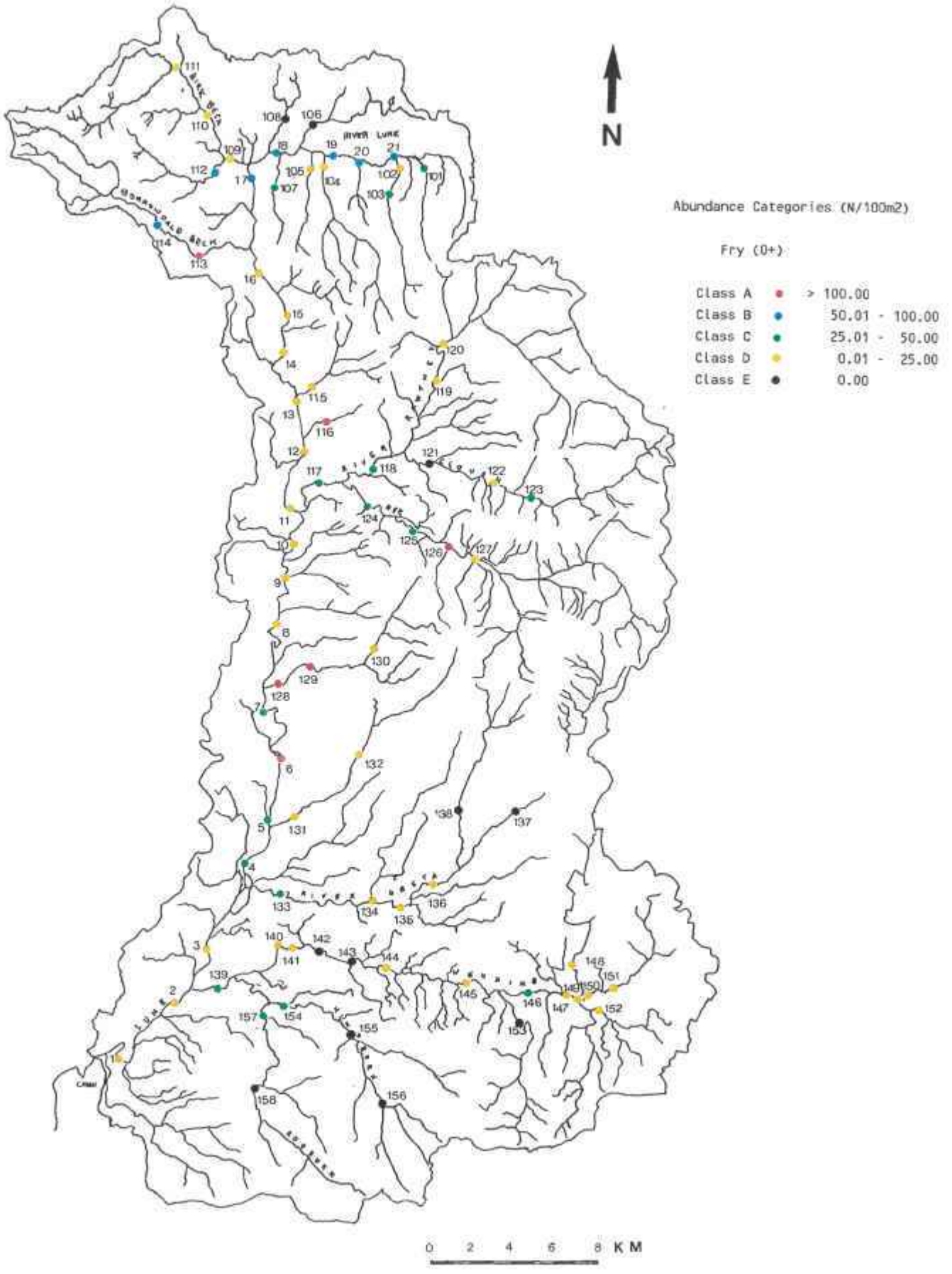
At the Barbon Beck/Leck Beck system 40% of the sites were class A and 60% were class D (n=5). The class A sites were at the lower reaches of Barbon Beck (sites 128, 129).

The sites of the Greta ranged from class C to E . The upstream sites (137, 138) did not support any 0+ salmon at the time of the survey and this may in part be due to the waterfalls which act as barriers to adult fish (Fig. 1).

The number of sites sampled in the Wenning subcatchment were increased from 5 in 1981 to 15 in 1982, but the majority of sites were still categorised as class D (66.7%); 20% were class E and 13.3% class C.

There was some improvement in densities at the lower sites of the Hindburn/Roeburn system (site 157 improved by 1 class and site 154 by two classes) although sites 155, 156 and 158 remained class E.

Fig. 5 0+ Salmon Densities In The River Lune Catchment 1982



The records show that 197,556 eyed ova and 670,619 salmon fry were stocked out in the Lune catchment in 1982. The results of the 1982 juvenile salmonid survey suggest a certain degree of correlation between some stocked areas and survey sites associated with those areas.

Croasdale Beck was stocked with 10,000 eyed ova immediately upstream of site 116 where excellent densities of fry were recorded in the subsequent survey (251.3+/-123.7/100$m^2$, class A).

Borrowdale Beck was stocked with eyed ova (49,550) and fed fry (17,217) upstream of sites 114. This site and the downstream site 113 proved to be quite productive with densities of 74.9+/-9.5/100$m^2$ and 120.5+/-12.1/100$m^2$ respectively (class B, A).

The stocking of 17,138 fry in the vicinity of Bretherdale Beck (site 112) may have resulted in the good density of fry recorded at this site (class B).

Eyed ova were stocked in the upstream vicinity of site 101 Weasdale Beck (20,836) and site 21 Lune (19,765). In these instances there was potential for the movement of fry downstream into the survey sites where densities of class C and class B were recorded.

In other regions of the catchment there was no discernible link between stocked areas and observed densities at sites associated with these areas and as mentioned earlier one of the reasons could be the distance between the stocked area and survey sites being too great. Alternatively, the stocking density might not have been sufficient to register a change in classification. 12,000 fry were stocked in the upper reaches of Barbon Beck but made no significant impact on the density of fry recorded at site 130 (class D) in the subsequent survey. By contrast the downstream sites 128 and 129 produced excellent densities of fry and as there is no record of fry or ova being stocked there these high densities must be attributable to natural production.

122,237 fry were planted in the River Lune over a 2.4km section which incorporated site 16, however the recorded density at this site was only 19.3+/-1.7/100$m^2$ (class D). The habitat at this site may not be able to support higher densities of juvenile salmon.

80,000 unfed fry were planted in the Wenning between sites 144 and 145 but both of these sites had low 0+ densities (class D). A further 3.2 km section was stocked with 80,000 unfed salmon fry incorporating sites 141, 142 and 143. The results of the post stocking survey suggests that survival has been very poor, no fry being recorded at sites 142 and 143 and a density of 4.3+/-3.8/100$m^2$ being recorded at site 141 (class D).

40,000 salmon fry were stocked between sites 154 and 155 on the River Hindburn. The results of the 1982 survey shows that

although no fry were recorded at site 155 a density of 27.6+/-11.5/100m$^2$ was recorded at site 154 (class C) which was a class E site in 1981.

### 4.1.4 1+ Salmon 1982

The percentage of sites in the density categories A, B and C were lower than that recorded in 1981 (Figs. 3 and 6). 2.53% of the sites sampled were class A (5.88% in 1981), 11.39% class B (15.67% in 1981) and 17.72% class C (21.57% in 1981). Class D sites had increased from 41.18% to 45.57% and class E sites from 15.67% to 22.79%. This may reflect the change in sampling strategy with equal fishing effort for age classes being adopted rather than concentrating on the capture of parr as in 1981.

The Lune and its tributaries upstream of site 17 (subcatchment 1) was dominated by class C sites (50%) followed by class D (25%), class B (16.7%) and class A (8.3%) sites (n=12). The upper Lune sites 20 and 21 produced high densities of parr (10.3+/-1.1/100m$^2$ and 17.4+/-5.3/100m$^2$ respectively, class B). These sites were part of an area stocked with 10,000 fry in 1981 and this may have enhanced natural production. Similarly 20,2767 fry were stocked between sites 18 and 19, although parr densities at these sites were found to be class D and C (3.1+/-0.9/100m$^2$ and 7.5+/-3.7/100m$^2$ respectively).

Weasdale Beck (101) was one of only two sites in the Lune catchment which had an excellent density of parr (class A) and this must be due to natural production as there is no record of any stocking having taken place in the area.

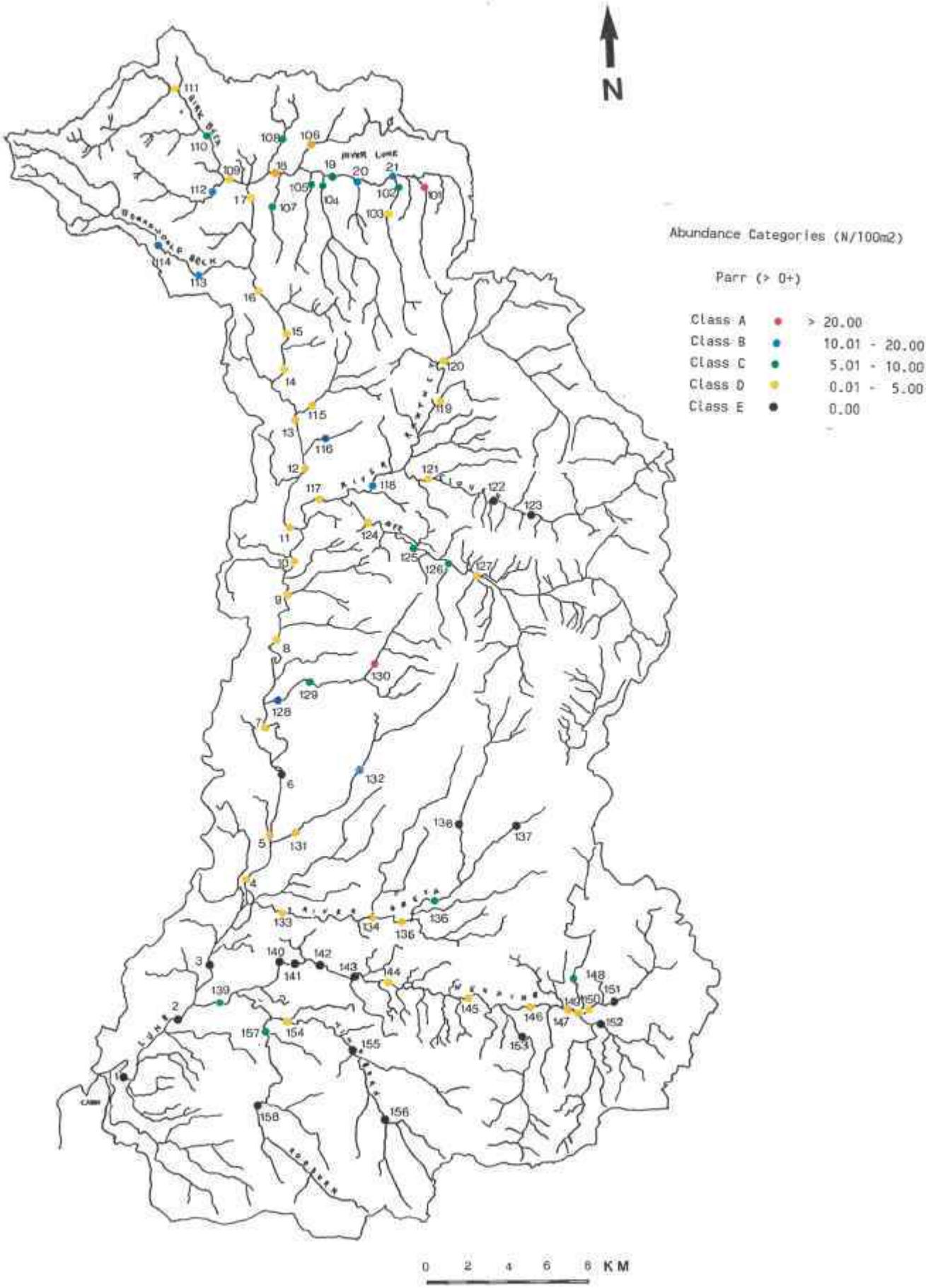
The main river sites 14 and 12 had low parr densities (class D) even though a total of 14,015 fry had been planted in the vicinity of these sites in 1981. Two factors may be important here. The main river sites because of their habitat may not be able to support higher densities of fry and the nature of these wide sites may make it difficult to capture parr.

In subcatchment 5 the two Borrowdale Beck sites were quite productive (class B) while the Birk Beck sites (109, 110 and 111) ranged from class D to C on the main beck with the tributary site 112 (Bretherdale Beck) being categorised as class B. A 4.8km section of Borrowdale Beck was stocked with 22,000 fry in 1981. Site 114 was in this area and was found to have a good density of parr in 1982 (class B). A similar density was recorded at site 113 which was just downstream of the stocked zone and may have received fry or parr being displaced from the stocked zone.

Croasdale Beck (site 116) was stocked with 10,930 eyed ova in 1981 which may have resulted in the high densities of parr recorded at this site in 1982 (class B).

The Dee (subcatchment 9), Clough (subcatchment 8) and Rawthey (subcatchment 7) were rather unproductive with 54.5% of sites

Fig. 6 1+ Salmon Densities In The River Lune Catchment 1982



being class D, 18.2% class E, 18.2% class C and 9.1% class B (n=11).

The Barbon Beck/Leck Beck system was quite productive with the 3 Barbon Beck sites ranging from class A to C and the two Leck Beck sites being categorised as class A and D. The excellent density of salmon parr recorded at site 130 on Barbon Beck (33.9+/-5.2/100$m^2$, class A) was a direct consequence of the stocking of 15,766 fry in this region in 1981. Natural productivity cannot have accounted for the high density of parr since access to this site for spawning fish is prevented by two waterfalls.

The Hindburn/Roeburn, Wenning, Greta and Lune downstream of site 18 were relatively unproductive. Hindburn/Roeburn sites 155, 156 and 158 were again categorised as class E. The Wenning was dominated by class D and class E sites (40% and 46.7% respectively, n=15). With the exception of one class C site the remaining sites on the Greta were class D/E (n=6). Of the 17 sites comprising the upper middle, lower middle and lower Lune 76.5% were class D and 23.5% class E.

### 4.1.5 0+ Salmon 1983

The percentage of sites held in each density category did not vary much from the 1982 results (Figs. 3 and 7) although it was noticeable that class B sites had increased as had class E sites whereas class A and class C sites had decreased.

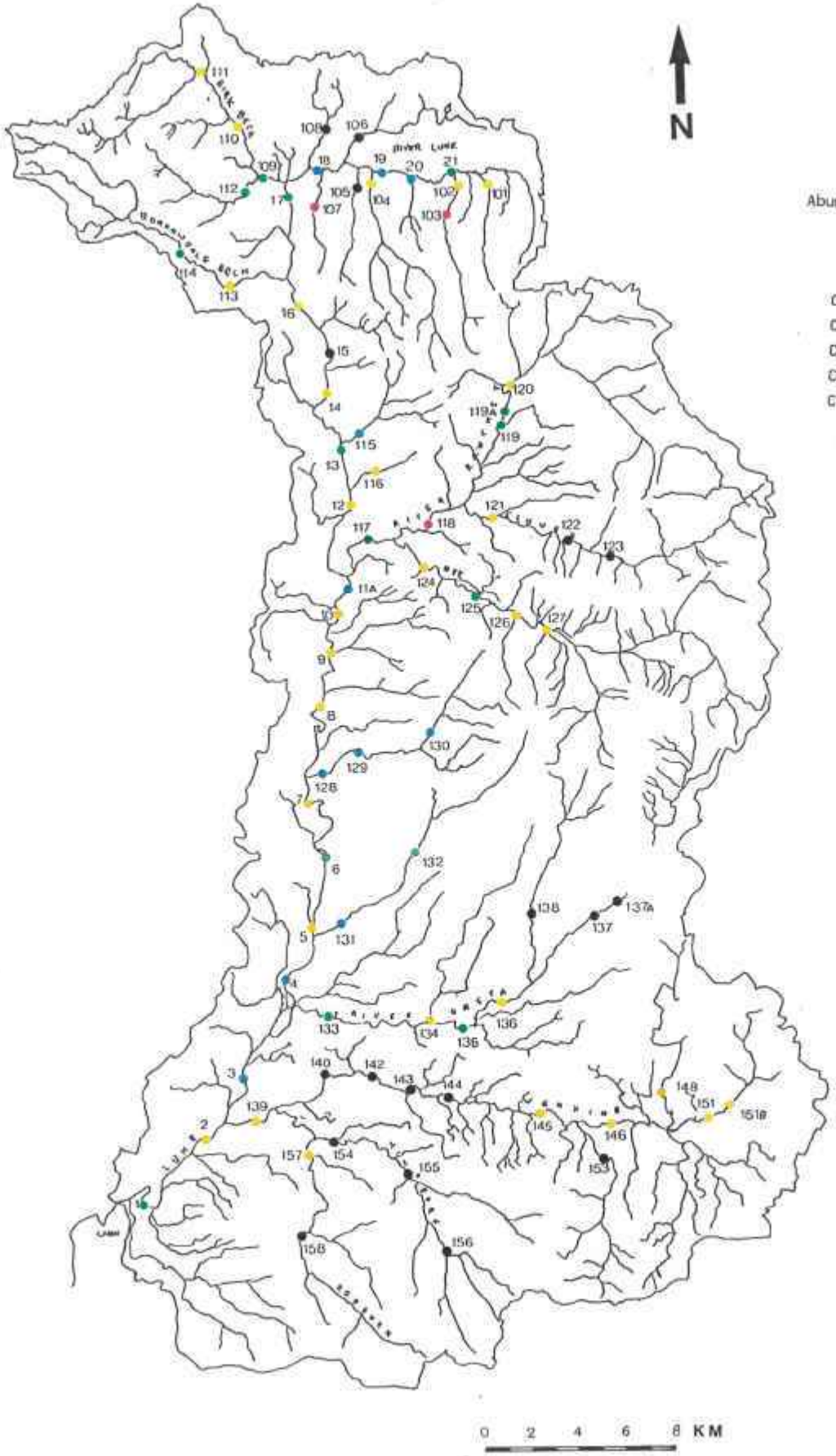
A certain degree of differentiation was again evident between densities at sites of the upper Lune and its tributaries. With the exception of sites 107 (Tebay Gill) and 103 (Bowderdale Beck) (both class A) the rest of the tributary sites of the upper Lune catchment were either class D or E (n=8) while the Lune itself was dominated by class B sites (75% class B, 25% class C, n=4).

20,699 eyed ova were planted at Tebay Gill in 1983 and a density of 505.6+/-60.3/100$m^2$ was recorded during the 1983 survey at site 107 on Tebay Gill. It seems reasonable to assume that fry production at this site was enhanced by the prior stocking of eyed ova. The other class A site in this subcatchment was Bowderdale Beck (site 103), however there is no record of any stocking having taken place here. Thus the fry density of 143.4+/-34.9/100$m^2$ recorded at this sites must have been due to natural production.

Some good densities of fry were recorded at the lower Lune subcatchment (sites 1, 3 and 4; class C, B and B respectively), but the regions of the lower middle and upper middle Lune were dominated by sites of lower productivity (52.9% class D, 23.6% class C, 17.6% class B, 5.9% class E, n=17).

Chapel Beck (subcatchment 6) was stocked with 5,000 fry in the vicinity of site 115 where a density of 81.5+/-20.4/100$m^2$ was recorded placing it in a class B category. In contrast 15,000

Fig. 7 0+ Salmon Densities In The River Lune Catchment 1983



eyed ova were stocked just upstream of site 116 on Croasdale Beck, but seemed not to have influenced fry production at this site at the time of the survey (class D).

The Barbon Beck/Leck Beck system was quite productive being dominated by class B sites (80%, n=5). 9,634 fry were stocked in the vicinity of site 130 which accounts for the high density recorded at this otherwise inaccessible site.

The sites of the Birk Beck/Borrowdale Beck system (subcatchment 5) were categorised as class C (50%) and class D (50%) (n=6) and did not appear to have benefited from nearby stocked areas. Site 111 on Birk Beck was part of a 1.2km section stocked with 5,000 unfed fry, the observed density at this site during the 1983 survey was low (class D).

25,000 unfed fry were stocked over a 1.2km section in the vicinity of site 113 on Borrowdale Beck but the 0+ density recorded during the survey was only 21.1+/-1.3/100m$^2$ (class D). In addition to this 12,519 unfed fry were planted in a 2.4km stretch of Borrowdale Beck just upstream of site 114 and a 3.2km section planted with 24,836 eyed ova. The moderate densities at this site (class C) suggest that no significant enhancement took place although it is possible that class C represents a good density of fry for this area if the waterfall downstream of site 113 limits the number of adults migrating upstream.

75% of the sites sampled on the River Dee were categorised as class D and 25% as class C (n=4). The Clough was similarly relatively unproductive with 66.7% of sites being class E and 33.3% class D (n=3). The Rawthey proved to be more productive. Of the five sites sampled 60% were class C, 20% class A and 20% class D.

The Greta, Wenning and Hindburn/Roeburn sites were relatively unproductive. The three upstream sites of the Greta system were class E (42.8%) probably as a result of obstructions (Fig. 1), the other sites being class C (28.6%) and class D (28.6%). Of the 11 Wenning sites 54.5% were class D and 45.5% class E. A 3.2km section of the Wenning was stocked with 50,000 fed fry in the vicinity of site 145 but there was no significant evidence of this at the time of the survey when a density of 3.7/100m$^2$ (minimum estimate) was recorded (class D). 80% of the sites of the Hindburn/Roeburn system were class E and 20% class D (n=5) with sites 155, 156 and 158 being categorised as class E sites for the third year in succession.

### 4.1.6 1+ Salmon 1983

As can be seen from Figs. 3 and 8 there was some improvement in the overall density characteristics of the catchment compared to previous years, the main feature being an increase in the number of class A sites from 2.5% in 1982 to 7.8% in 1983. There were also fewer class E sites in 1983 (15.6%) compared to 1982 (22.8%).

The most productive ares of the catchment were subcatchments 5 (Birk Beck/Borrowdale Beck) and 1 (the upper Lune and its tributaries). In the former case 50% of sites were class B, 33% class A and 16.7% class C (n=6). In the latter case there was again some differentiation between the densities recorded at the sites of the tributaries against those recorded in the main river. Site 107 on Tebay Gill (class A), site 104 on Longdale Beck (class A), site 105 on Ellergill Beck (class A), site 101 on Weasdale Beck (class B), site 102 on Bowderdale Beck (class B) and site 20 on the Lune (class B) were the most productive of the subcatchment. Examination of the tributaries separately indicates that the main river sites were categorised as 50% class D, 25% class B and 25% class D (n=4). Of the tributaries 37.5% of sites were class A, 25% class B, and 12.5% for each of the categories C, D and E (n=8).

The density of parr at site 107 on Tebay Gill was found to be excellent (70.2+/-12.9/100$m^2$, class A), although 0+ density in 1982 was only moderate (43.7+/-4.1/100$m^2$, class C). 1+ salmon production at this site must have been enhanced by parr moving into this region from its immediate vicinity. It is possible that some of these fish resulted from the 20,836 eyed ova that were planted in this beck in 1982.

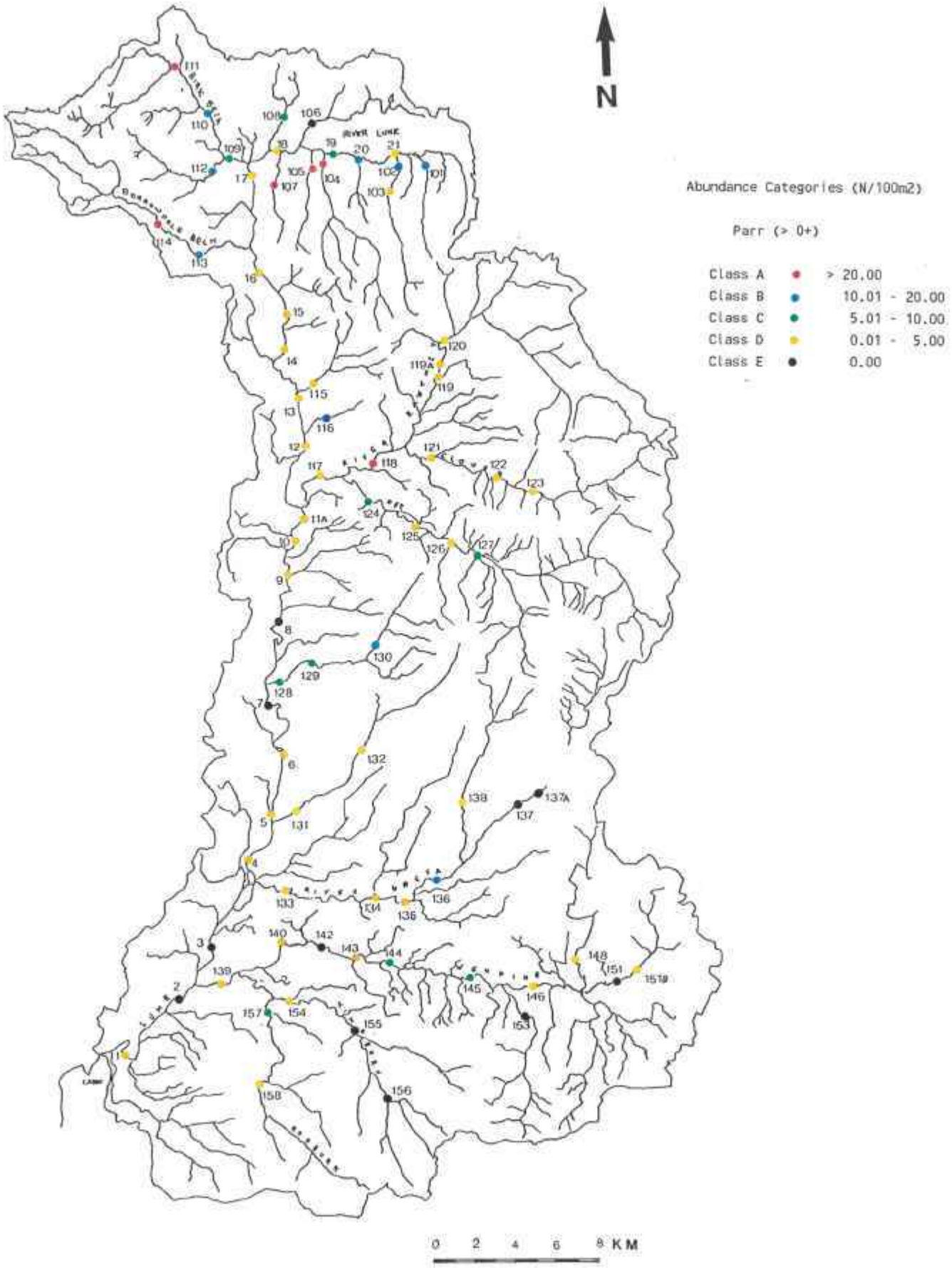
A similar situation of fish movement is indicated in Weasdale Beck and Ellergill Beck. 20,836 eyed ova were planted in Weasdale Beck in 1982. In 1983 parr production at site 101 was found to be class B and may have been due in part to the development and subsequent emigration of fish resulting from the eyed ova that were planted in 1982. The high parr density recorded at site 105 on Ellergill Beck (44.6+/-8.8/100$m^2$, class A) may well have been as a consequence of planting 15,825 eyed ova in the vicinity of this site in 1982. At the time of the 1982 survey 0+ production at this site was found to be low (class D).

Site 108 on Chapel Beck (subcatchment 1) had a moderate density of 1+ salmon (class C), but no fry were recorded there in 1982. Some of the fish that had moved into this area may have been those from the 20,000 fed fry that were stocked just upstream of this site in 1982.

19,765 eyed ova were stocked in the vicinity of site 21 on the upper Lune in 1982 where the fry density post stocking was found to be excellent (class A), however the density of parr in 1983 was relatively low (3.8/100$m^2$, class D).

Site 110 on Birk Beck (subcatchment 5) had a good density of parr (class B), but the density of fry in 1982 was low (class

Fig. 8 1+ Salmon Densities in The River Lune Catchment 1983



D). There may have been some enhancement as a result of fish movement from Rampshowe Beck, a small tributary just upstream of site 110. This beck was stocked with 20,744 eyed ova in 1982. An excellent density of salmon parr was recorded at site 111 on Birk Beck (class A) even though fry production in 1982 was low (class D). The stocking of 6,652 fry followed by a further 11,000 fed fry in the vicinity of this site in 1982 may have had a beneficial impact on parr densities. Site 112 on Bretherdale Beck had a good density of parr (class B). The basis of this was the high density of fry recorded in 1982 (class B), possibly as a result of the stocking of 17,138 fry in the main Beck, 5,000 in one tributary and 5,000 in another all of which were in the vicinity of site 112.

The main river sites up to site 17 were of low productivity being dominated by class D sites (76.5%) and the remaining sites were class E (23.5%, n=17). Site 16 on the River Lune was found to have low 0+ and 1+ salmon densities (class D), although 122,237 fed fry were stocked in the vicinity of this site in 1982.

Croasdale Beck (site 116) had a good density of salmon parr (class B). This beck had been stocked with 10,000 eyed ova in 1982 and was found to yield a fry density of 251.3+/- 123.7/100$m^2$ (class A) in the 1982 survey. The high density of parr recorded in 1983 was therefore to be expected.

The Dee (9), Clough (8) and Rawthey (7) were relatively unproductive. 50% of the River Dee sites were class C and 50% class D (n=4). All three of the sites sampled on the Clough were class D. Most of the Rawthey sites were class D (80%, n=5), the exception being site 118 which was class A. No stocking was carried out in the region of this site.

Of the Barbon Beck/Leck Beck system (subcatchment 10) the former was the most productive for parr, site 130 being class B and sites 128 and 129 class C. The two Leck Beck sites were categorised as class D. Site 130 on Barbon Beck was found to be a class B site even though fry densities in 1982 were low (class D). The region upstream of this site was stocked with 12,000 fed fry in 1982. Some of these fish must have been displaced and/or actively moved to the region of site 130.

The Greta, Wenning and Hindburn/Roeburn were again relatively unproductive, the majority of sites being class D (57%, 54.5%, and 40% respectively; n=7, 11 and 5).

The presence of parr at site 138 on the Greta (class D) is thought to be as a result of the stocking of 10,000 fry in 1982. Site 136 was found to have a good density of parr (class B), although fry production at this site in 1982 was low (class D). The region was stocked with 50,000 salmon fry in 1982 and this may have enhanced parr production to the degree observed in 1983.

80,000 unfed fry were planted in the Wenning in 1982 in the vicinity of site 142 and 143. In that same year no salmon fry were recorded at site 142 and 143. No parr were recorded at

site 142, whilst site 143 was categorised as class D in 1983. Parr densities at site 144 and 145 of the River Wenning were moderate (class C), and may have been due to the stocking of 80,000 fed fry in the region between these sites in 1982. The section between sites 154 and 155 on the Hindburn was stocked with 40,000 fry in 1982, but these fish do not appear to have impacted on salmon production at these sites. No parr were recorded at site 155 while 154 was class D. Fry were absent from site 155 in 1982 with a moderate density (class C) being recorded at site 154. This may be as a result of the habitat being unable to support high densities of salmon.

### 4.1.7 0+ Salmon 1984

The results of the 1984 survey indicates that this was a poor year for fry production in the Lune catchment compared to 1982 and 1983 with 57.9% of the sites being categorised as class D and 25% class E (Figs. 3 and 9). The percentage of class B and C sites were much lower than their 1982 and 1983 values. This may be related to fact that 1984 was a drought year.

The River Lune was dominated by class D sites. Of the 21 sites 80.9% were class D, 14.3% class C and 4.8% class E. The tributaries of the upper Lune subcatchment (1) were also dominated by class D sites, the only exception being Tebay Gill (site 107) which had an excellent density of fry (class A). This result is most likely to have occurred due to enhancement through the planting of 18,000 eyed ova in the vicinity of site 107.

The Birk Beck/Borrowdale Beck system was relatively unproductive, 83.3% of sites being class D and 16.7% class E (n=6).

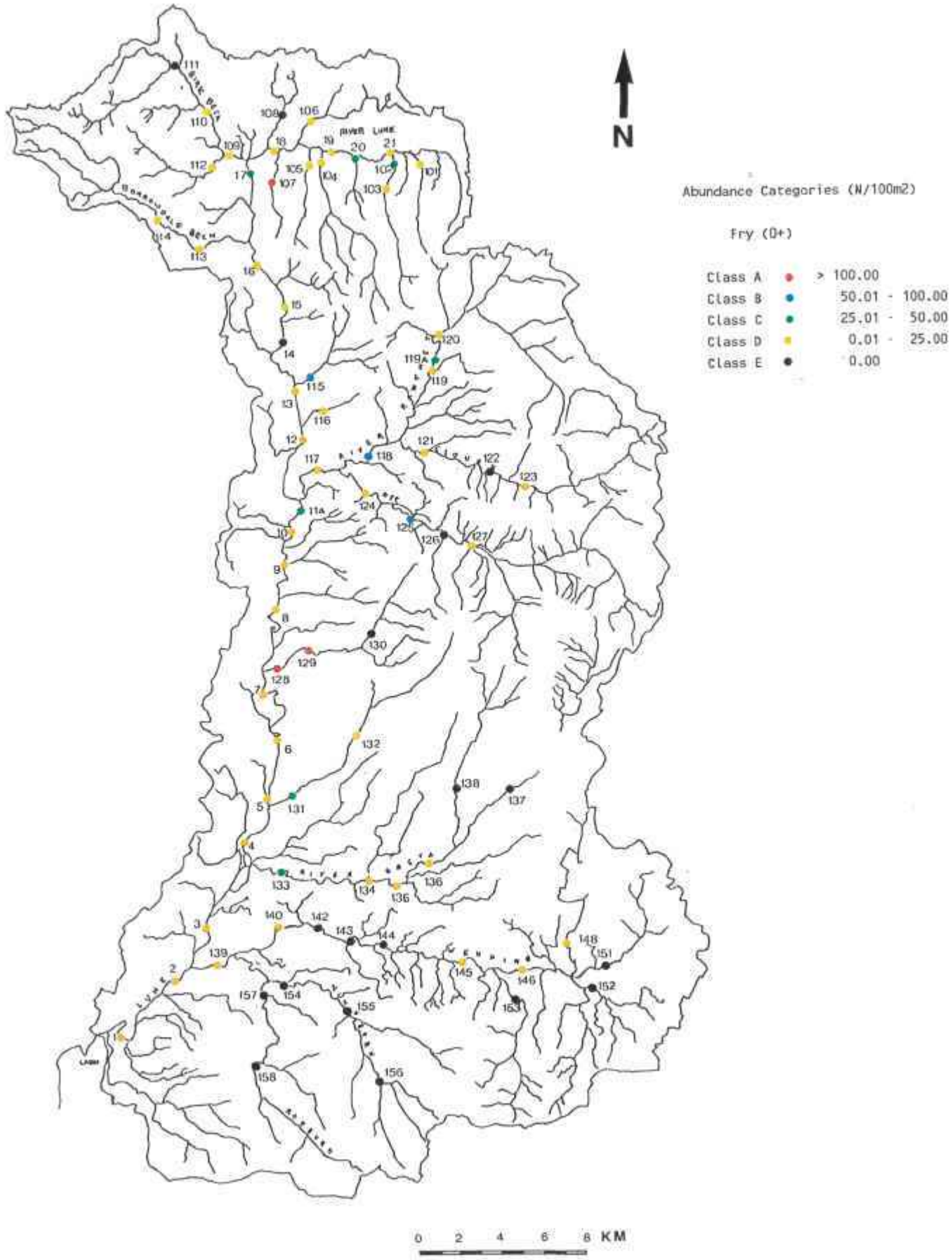
The Rawthey, Clough, and Dee were largely dominated by class D sites, but some good densities were found at Dee 125 and Rawthey 118 (both class B). The latter site has proved to be quite productive for juvenile salmon over the study period to date.

Of the Barbon Beck/Leck Beck system the former was more productive, sites 128 and 129 had excellent densities of fry (class A). No fry were recorded at site 130 on Barbon Beck and this is a direct result of the fact that adult salmon are unable to negotiate two waterfalls downstream of this site. 16,000 fry were stocked out over a 3.2km stretch in the vicinity of site 130, but made no impact on densities at this site at the time of the survey. Sites 131 and 132 on Leck Beck were categorised as class C and D respectively.

50% of the sites on the Greta were class D, 33.3% class E and 16.7% class C. The class E sites (137 and 138) were those upstream of waterfalls.

The Wenning (subcatchment 12) was dominated by class E sites (54.5%, n=11). 49,539 unfed fry were planted in the River

Fig. 9 0+ Salmon Densities In The River Lune Catchment 1984



Wenning incorporating site 144, however no fry were recorded at this site in the 1984 survey.

No fry were recorded in the Hindburn/Roeburn system (subcatchment 13).

### 4.1.8 1+ Salmon 1984

1984 has so far been the most productive year for salmon parr during the study period. 18.4% of the sites in the catchment were categorised as class A, 17.1% class B and 18.4% class C (Figs. 3 and 10).

The upper Lune and its tributaries (subcatchment 1) was a relatively productive system with most of the high density sites being on the tributaries. 33.3% of the sites were class A, 41.7% class C, and sites in categories B, D and E forming 8.3% of the system.

Site 107 on Tebay Gill had a 1+ density of 61.6+/-2.3/100m$^2$ (class A) and was based on the excellent density of fry recorded in 1983 (class A). This in turn was most probably due to the planting of 20,699 eyed ova in 1983.

Site 105 on Ellergill Beck had a moderate density of parr (class C) although no fry were recorded at the time of the 1983 survey. However, 12,000 eyed ova were planted upstream of this site in 1983 and this may have supplemented any natural movement of fry into this area.

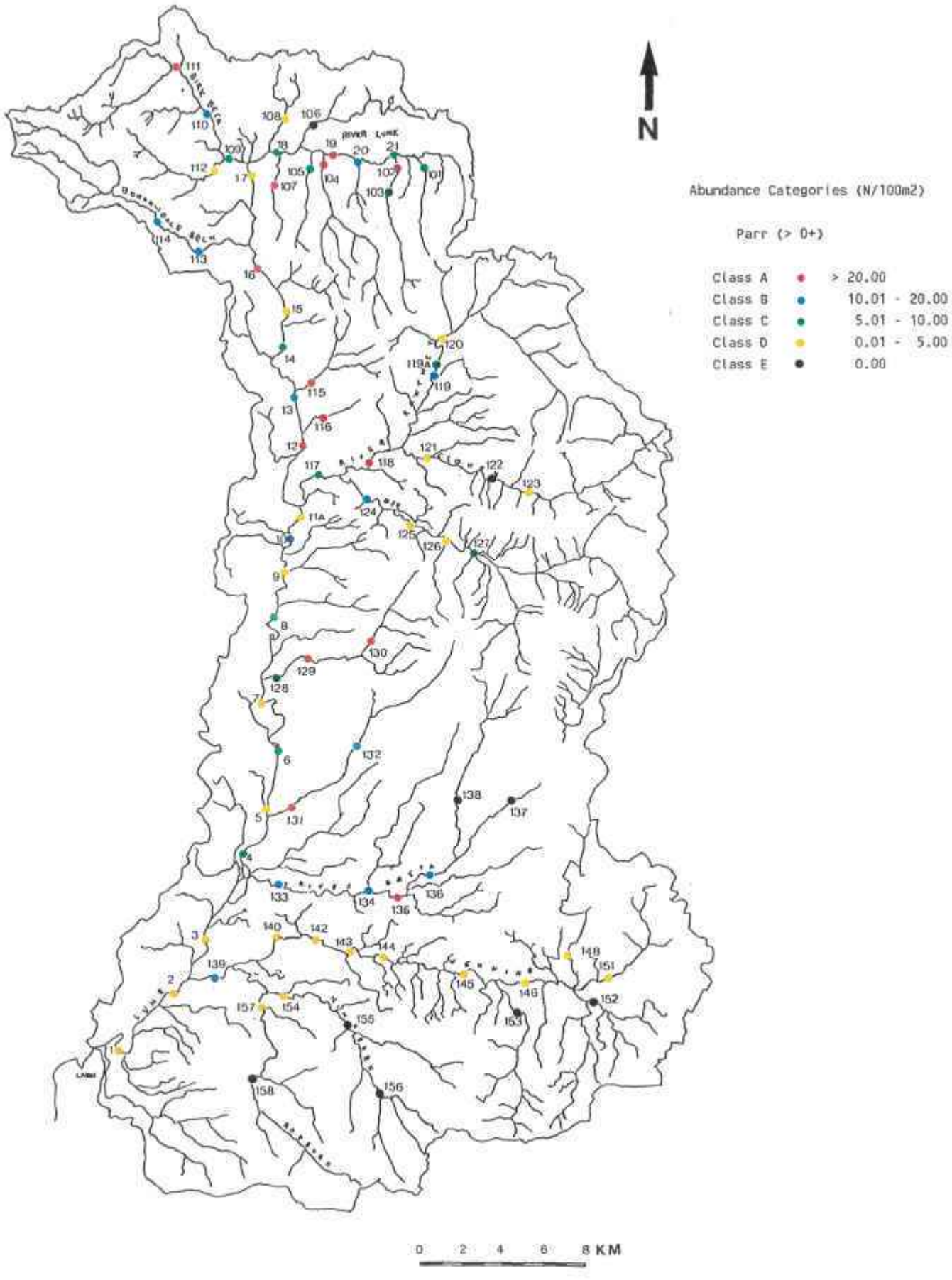
The Birk Beck/Borrowdale Beck sites were also relatively productive, 50% of sites being class B and the remainder falling in the categories A, C and D (n=6). 5,000 fry were stocked in the vicinity of site 111 (Birk Beck) in 1983 and may well have contributed to the high density of parr recorded there in 1984 (33.2+/-4.1/100m$^2$, class A).

The two sites on Borrowdale Beck (113, 114) were categorised as class B, but since fry production was found to be relatively low in 1983 (class D and C respectively), parr densities may have been enhanced by the influx of fish from adjacent stocked areas. 24,836 eyed ova were planted just upstream of site 114, 25,000 unfed fry in the vicinity of site 113 and a further 12,519 unfed fry just upstream of site 114 in 1983.

The upper middle Lune sites in particular (subcatchment 2) and the lower middle Lune sites (subcatchment 3) produced some relatively good densities of parr. In the former case 28.6% of the sites sampled were class A and 14.3% class B (n=7). In contrast the lower Lune system (subcatchment 4) was dominated by class D sites (80%, n=5).

Site 116 on Croasdale Beck and site 115 on Chapel Beck were class A sites. Fry production at site 116 was low in 1983 (class D), thus the high parr densities must have been achieved through the movement of fish into this site some of

Fig. 10 1+ Salmon Densities In The River Lune Catchment 1984



which may have resulted from the planting of 15,000 eyed ova immediately upstream of this site. In the case of site 115 the density of 0+ fish in 1983 was good (class B) giving rise to the high density of parr in 1984. These results may also have been due in part to the stocking of 5,000 fed fry immediately upstream of this site in 1983.

Whereas in previous studies the Rawthey, Clough and Dee, were of similar density categories the Rawthey was more productive on this occasion. Site 118 was again found to have an excellent density of salmon parr (class A). Of the remaining sites 2 were class C, 1 class B and 1 class D. Site 124 was the most productive site of the Dee subcatchment (class B), the rest of the sites being class C (25%) and class D (50%, n=4). The Clough was again relatively unproductive. Of the three sites sampled 2 were class D and 1 class E.

The Barbon Beck/Leck Beck system was highly productive with 60% of sites being class A, 20% class B and 20% class C (n=5). An excellent density of parr was recorded at site 130 on Barbon Beck (class A) and a good density of fry was recorded at this site in 1983 (class B). These results are due to the stocking of 9,643 fed fry in 1983. There was no evidence of any stocking having taken place in Leck Beck (sites 131 and 132), so the class A and class B densities recorded there are attributable to natural production.

Most of the Greta sites yielded very good densities of parr. 50% of sites were class B and 16.7% class A (n=6). There is no record of any stocking having been carried out here so these densities must have been due to natural production.

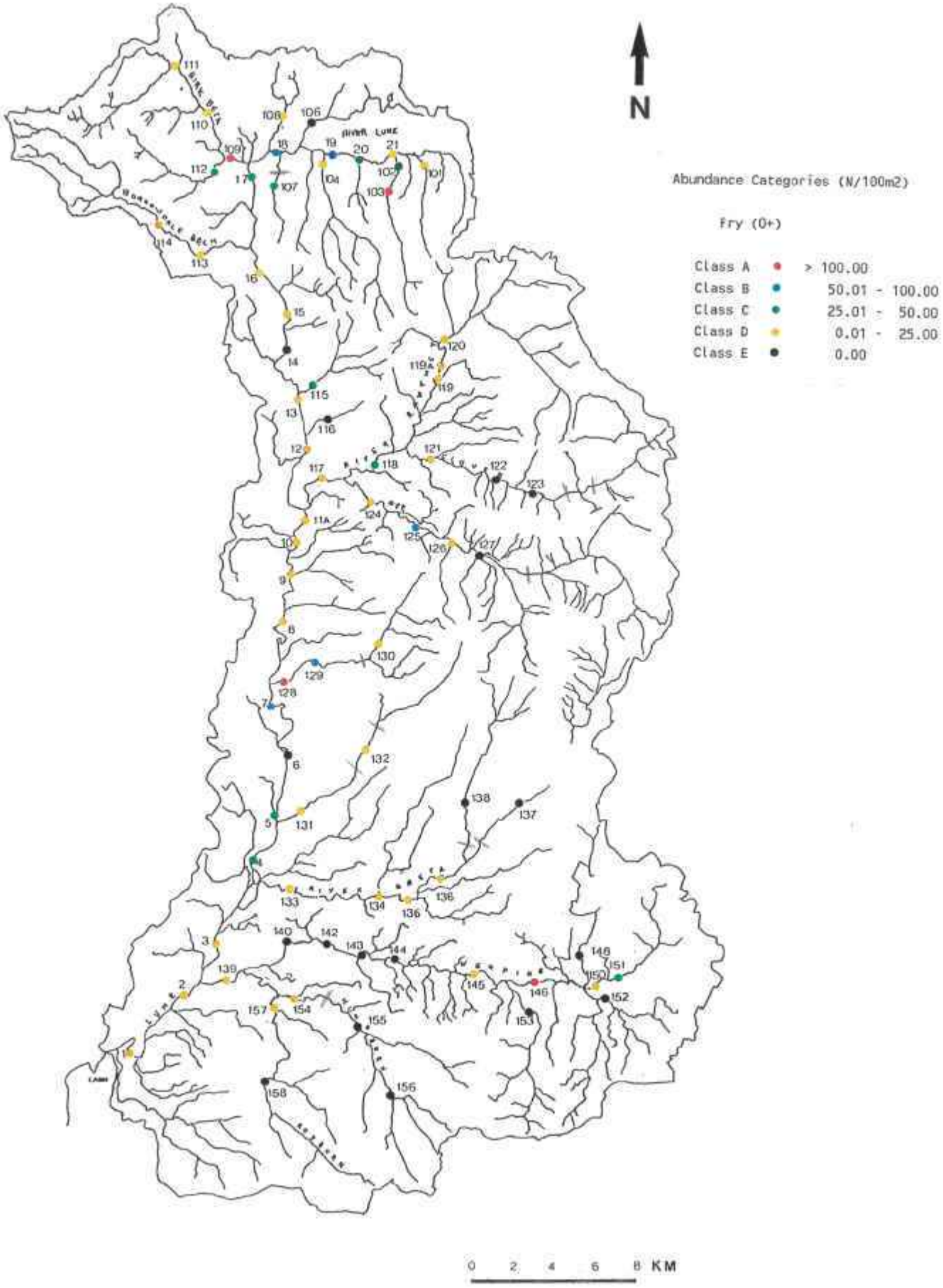
The Wenning system and the Hindburn/Roeburn system were relatively unproductive. In the former case 72.7% of the sites were class D. Site 139 on the Wenning was the most productive site of the subcatchment (class B). Site 145 had a low density of parr (1.9+/-0.9/100$m^2$, class D) as was the case with fry at this site in 1983 even though 50,000 fry had been stocked in the vicinity of this site in 1983. The habitat may not be able to support high densities of fry. Site 155, 156 and 158 of the Hindburn/Roeburn were class E as they have been over most of the study period.

### 4.1.9 0+ Salmon 1985

There was some improvement in fry production compared to that observed in 1984 with an increase in the percentage of sites classed as A, B and C, however 75% of the sites studied belonged to class D and E categories (Figs. 3 and 11).

The sites of the upper Lune and its tributaries (subcatchment 1) had quite variable densities. 45% of the sites in this system consisted of class D sites, 27% class C, 18.2% class B and 9% class A. The main river sites were on the whole more productive than those of the tributaries. Of the 4 main river sites 2 were class B, 1 class C and 1 class E. The sites of the tributaries Chapel Beck (108), Rais Beck (106), Longdale

Fig. 11 0+ Salmon Densities In The River Lune Catchment 1985



Beck (104) and Weasdale Beck (101) were all class D sites. The most productive site of the subcatchment was site 103 on Bowderdale Beck (class A) and this was not stocked.

A moderate density of fry was recorded at site 107 on Tebay Gill (class C). A 3.2km section of this beck incorporating site 107 was stocked with 42,829 eyed ova but seems to have had little effect in the way of increasing the density of fry at this site.

The majority of sites on the Birk Beck/Borrowdale Beck system were class D sites (66.7%, n=6), the exceptions being sites 109 on Birk Beck (class A) and 112 on Bretherdale Beck (class C).

The main river up to site 17 (incorporating subcatchments 2, 3 and 4) was dominated by class D sites (64.7%) and it was only at site 7 (Linderlay) where densities exceeded 50/100m$^2$ (class B).

No fry were recorded at Croasdale Beck (site 116). There has been a downward trend in numbers since 1983. A 2.4km stretch of the beck immediately upstream of this site had been stocked with 16,941 eyed ova in 1985 but did not appear to influence 0+ densities at this site. 0+ density at Chapel Beck (site 115) was found to be moderate (class C). This site was just downstream of a 3.2km section stocked with 10,000 unfed fry, but it seems that this stocking had no major effect on 0+ density at the time of the survey.

The Rawthey, Clough and Dee subcatchments were relatively unproductive being dominated by class D sites. The most productive areas of this group were sites 125 on the Dee (class B) and 118 on the Rawthey (class C).

Sites 128 and 129 on Barbon Beck had high densities of fry (class A and B respectively) and have generally been very productive areas for salmon. Both Leck Beck sites (131 and 132) were class D as was site 130 on Barbon Beck. In the latter case the presence of fry was as a result of the stocking of 35,170 unfed fry in an area otherwise inaccessible to salmon.

The Greta, Wenning and Hindburn/Roeburn systems were relatively unproductive with a significant proportion of sites being categorised as class E (52.2%, n=23). The 4 main River Greta sites were all class D sites, while the 2 upstream sites were class E. 58.3% of the Wenning sites were class E and 25% class D (n=12). 20,000 unfed fry were stocked between sites 144 and 145 on the Wenning but made little impression on 0+ densities at these sites (class E and D respectively). Rather surprisingly in the context of the nature of the subcatchment, site 146 was found to have an excellent density of fry (class A). Sites 155, 156 and 158 of the Hindburn/Roeburn did not support any 0+ salmon at the time of the survey, while sites 154 and 157 were categorised as class D.

**4.1.10 1+ Salmon 1985**

1985 was the least productive year for 1+ salmon during the 1981 to 1985 period with 76.3% of the sites sampled in the catchment being categorised as class D/E. 9.2% of the sites were categorised as class B and 1.3% class A (Figs. 3 and 12). The results of the 1984 survey showed that fry production was relatively low and a likely consequence of this would be a poor year class of parr in 1985.

The sites of the upper Lune and its tributaries (subcatchment 1) were not as productive as in previous years and this was particularly noticeable with respect to the tributary sites. The only exception was site 106 (Rais Beck) which had previously yielded low densities of fry and parr, but produced a high density of parr in 1985 (class B). 14,971 unfed fry were stocked in this beck upstream of site 106 and the downstream displacement of these fish may be responsible for the observed density of parr.

The density of parr at site 107 on Tebay Gill (class C) was not as high as that expected considering the fact that this site had an excellent density of fry in 1984 (class A). The high fry density was likely to have been as a result of the planting of 18,000 eyed ova in a 2.4km section in the vicinity of site 107 prior to the survey.

Of the Birk Beck/Borrowdale Beck system the latter was more productive, sites 113 and 114 being registered as class B. This beck had been stocked with eyed ova (33,000) and unfed fry (9,300) in 1984 and the high densities of parr recorded at these sites may have been due in part to these stockings. The majority of sites on Birk Beck were categorised as class D (75%, n=4).

The main river was dominated by class D sites along its entire length (80.9%, n=21), the most productive site being Yorkshire Bridge (site 16) which was categorised as class B.

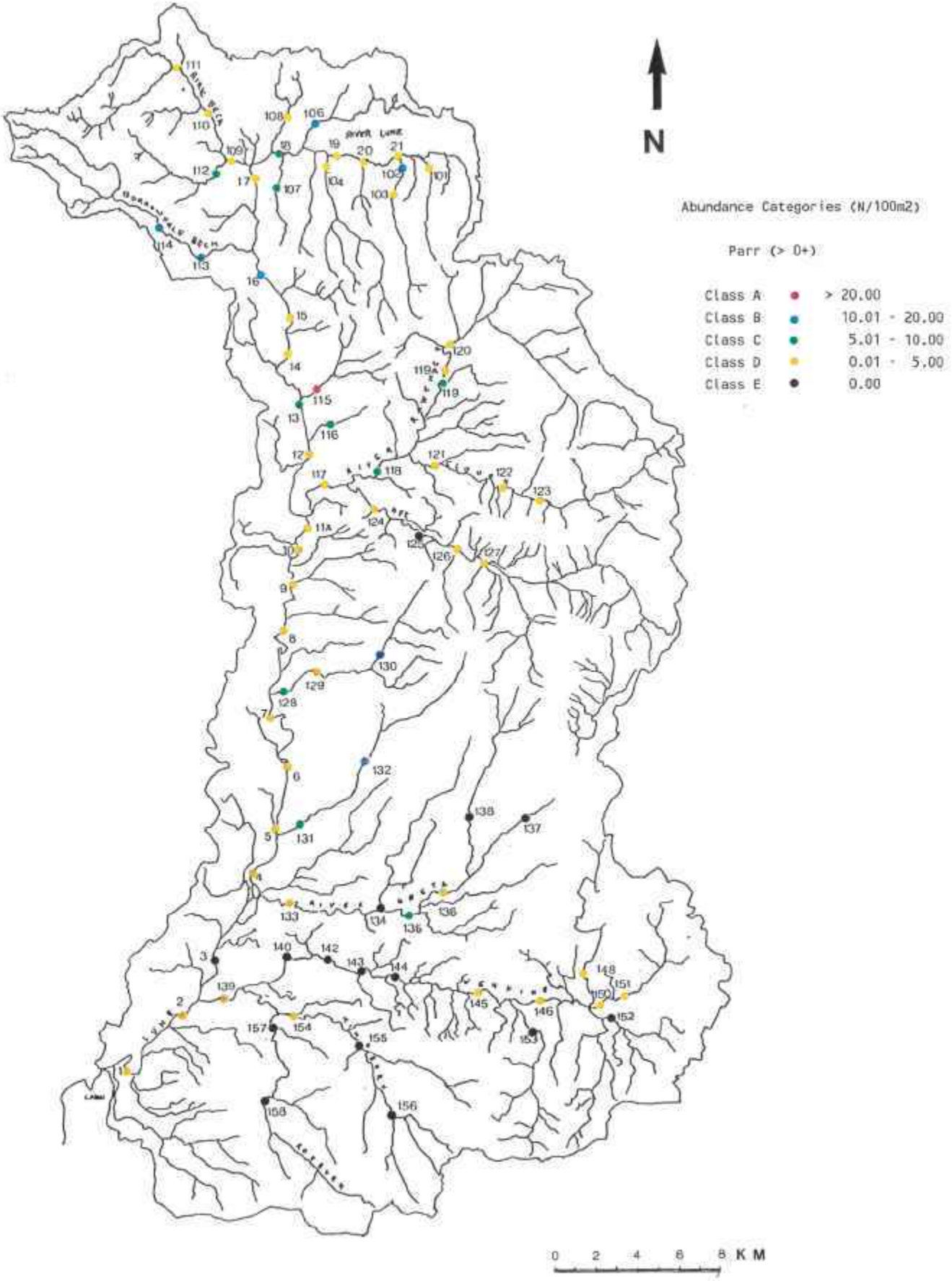
Site 115 on Chapel Beck was the only site in the catchment to yield parr densities in excess of 20/100m$^2$ (class A). There was no evidence of any stocking having taken place.

The Greta, Clough and Dee were dominated by class D sites (75%, n=12).

At the Barbon Beck system 40% of sites registered as class B and 40% as class C (n=5). Site 130 was found to have a good density of 1+ salmon (class B), but no fry were recorded here in 1984. 16,000 fry were stocked in the vicinity of this site in 1984 and the movement of these fish into the survey site accounts for the observed densities of parr in 1985 in view of the inaccessibility of this site for salmon.

Of the 23 sites sampled on the Greta, Wenning and Hindburn/Roeburn systems 22 had densities less than class C.

Fig. 12 1+ Salmon Densities In The River Lune Catchment 1985



## 4.2 0+ and 1+ Trout Densities 1981-1985

### 4.2.1 0+ Trout 1981

0+ trout densities in the Lune catchment were found to be extremely low during the 1981 survey (Figs. 3 and 13). It must be stressed that during this survey the emphasis was placed on salmon parr population estimates and as a consequence the results for 0+ trout (and 0+ salmon) may under represent the population. It would therefore be more appropriate to consider these results as minimum estimates. 44% of the sites sampled were of class E densities and the remaining 56% of the sites in the catchment had densities less than 25/100m$^2$ (class D).

The main river seemed to be unfavourable for fry production since no trout fry were recorded at any of the sites sampled (n=12).

### 4.2.2 1+ Trout 1981

A large proportion of sites sampled were of low productivity and the highest density categories were class B and C which accounted for 17.6% of the sites in the catchment. As was the case for trout fry all the main river sites (n=12) did not support any trout parr at the time of the survey (Figs. 3 and 14).

The Hindburn/Roeburn system was the most productive of the catchment with 60% of sites being class C and 40% class B (n=5). This system seems to be more favourable for trout production than salmon. Site 103 on Bowderdale Beck and 132 on Leck Beck were the only other areas of good production recorded during the 1981 survey (class B).

A total of 34,000 fed fry was planted in the main tributaries of the lower Lune (namely the Greta, Wenning and Hindburn, subcatchments 11, 12 and 13) in 1980. 12,000 of these were planted in the Greta between sites 134 and 135, but no trout parr were recorded at these sites during the 1981 survey. 11,000 fry were stocked in the River Wenning over a 0.8km section to include site 145. The 1981 survey revealed a parr density of 2.8+/-0.3/100m$^2$ (class D), seemingly unimpacted by the stocking event of 1980. 11,000 fry were planted in the upper reaches of the Hindburn but the exact location is not known, densities in the Hindburn ranged from class C to B.

### 4.2.3 0+ Trout 1982

There was an improvement in the overall density characteristics of the catchment compared to the results of the 1981 survey, largely due to a combination of two factors. Firstly, sufficient emphasis was placed on the capture of trout fry to give accurate population estimates at the sites sampled. Secondly, the number of sites sampled had increased from 51 in 1981 to 79 in 1982 and some of these additional

Fig. 13 0+ Trout Densities In The River Lune Catchment 1981

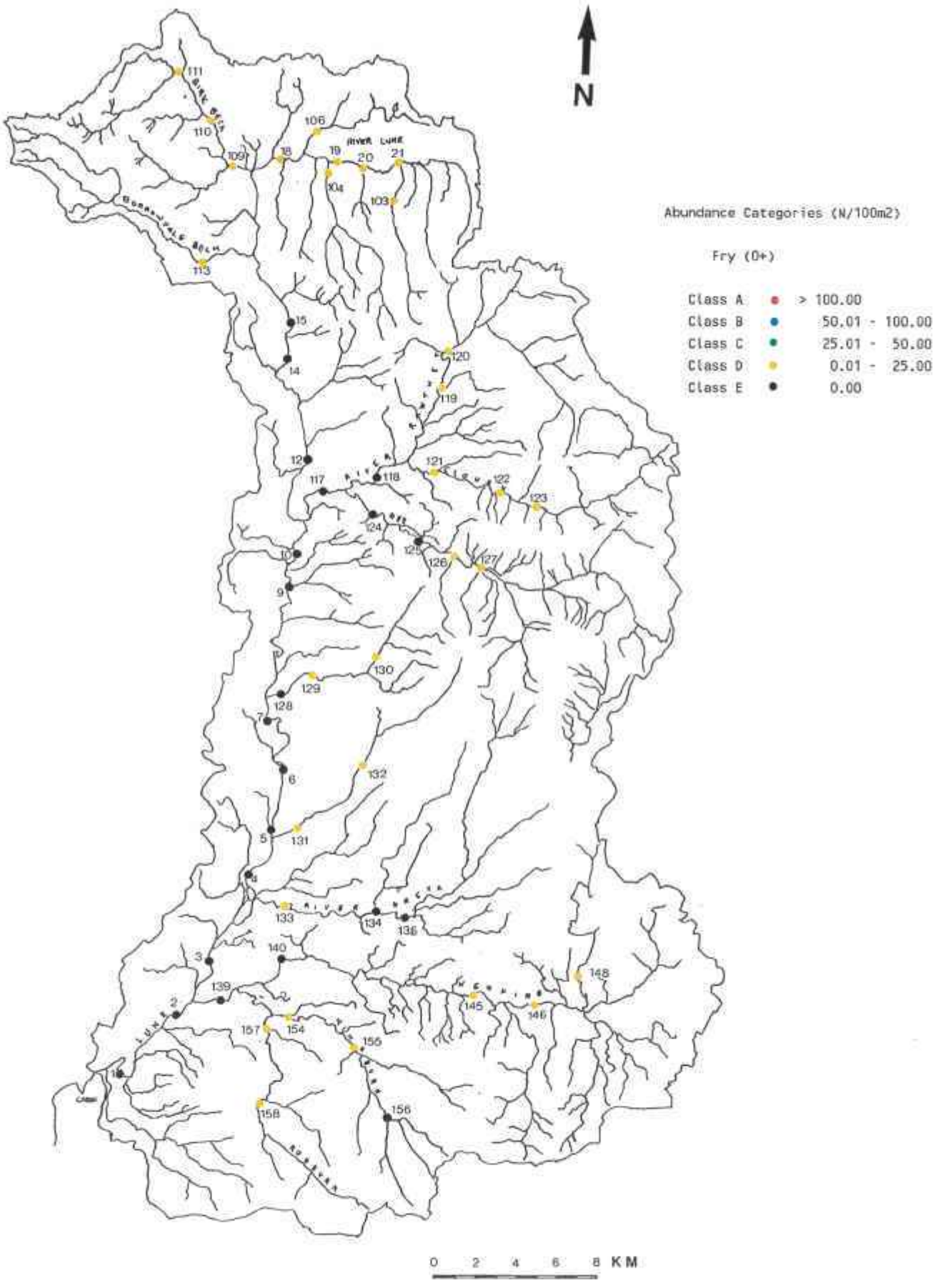
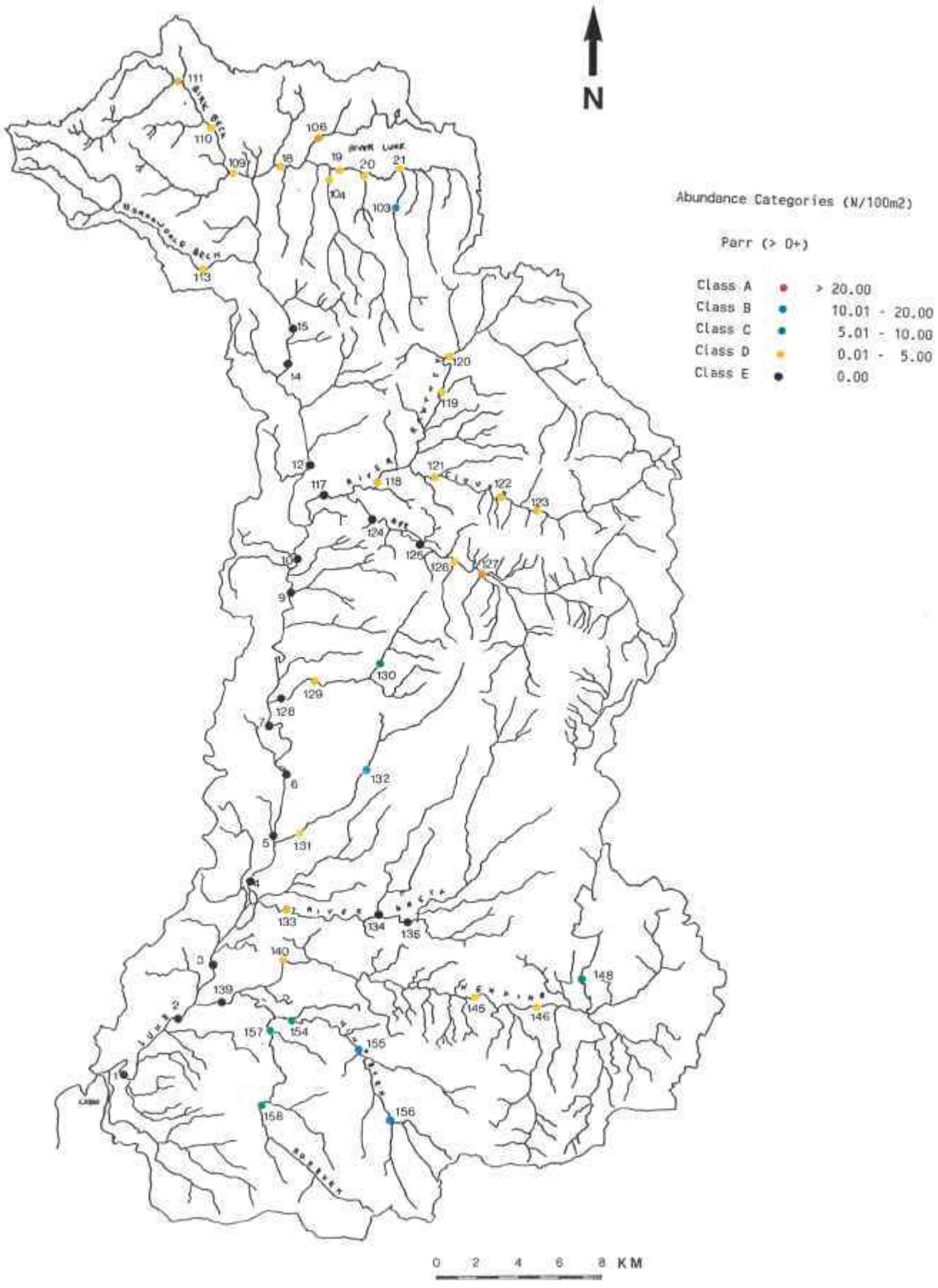


Fig. 14 1+ Trout Densities In The River Lune Catchment 1981



sites were found to be highly productive e.g. site 116 on Croasdale Beck and site 101 on Weasdale Beck (class A).

77% of the sites sampled were class D/E, 15% class C, and 7% class A/B (Figs. 3 and 15). Thus although there was an improvement in 0+ densities compared to that recorded in the 1981 survey it was localised in distribution.

Trout fry were present at some of the main river sites but densities were low. The lower lune sites (subcatchments 3 and 4) were predominantly class E while the upper Lune sites (subcatchments 1 and 2) were predominantly class D.

Sites 122 (class B) and 123 (class A) on the River Clough were more productive than in 1981 and this may be linked to the 1982 stocking programme. The records show that 10,189 fed fry were planted over a 2.8km section in the vicinity of site 123 and this may have contributed to the high densities recorded there.

#### 4.2.4 1+ Trout 1982

As can be seen from Figs. 3 and 16 the 1982 results are a considerable improvement on those obtained in 1981. The most significant feature is that 6.3% of the sites in the catchment were categorised as class A whereas in 1981 no class A sites were recorded. The percentage of class B and class C sites had also increased. The fact that parr densities were higher than that recorded in 1981 also tends to indicate that the 1981 0+ trout data was unrepresentative of catchment productivity in that year.

The Hindburn/Roeburn system proved to be the most productive of the catchment with 40% of sites categorised as class A and 40% as class B (n=5). Certain areas of the Wenning were just as productive as the Hindburn/Roeburn system and some of these were the additional sites incorporated in the sampling programme for 1982. The majority of sites were class D (40%), with 26.7% class B, 13.3% class C and 6.7% class A.

As was the case for fry, sites 122 and 123 on the Clough had high densities of parr (class A).

The sites sampled in the lower Lune and lower middle Lune subcatchments (3 and 4) were all class E sites. There was a slight improvement in density categories in the upper middle and upper Lune subcatchments (1 and 2).

#### 4.2.5 0+ Trout 1983

Although the percentage of class A sites was reduced compared to the results of the 1982 survey (from 5.0% to 1.3%) there was a slight overall improvement in the percentage of sites falling into the upper density categories (Fig. 3). Class B sites had increased from 2.5% to 11.7% and class D sites had also increased whilst class E sites decreased.

Fig. 15 0+ Trout Densities In The River Lune Catchment 1982

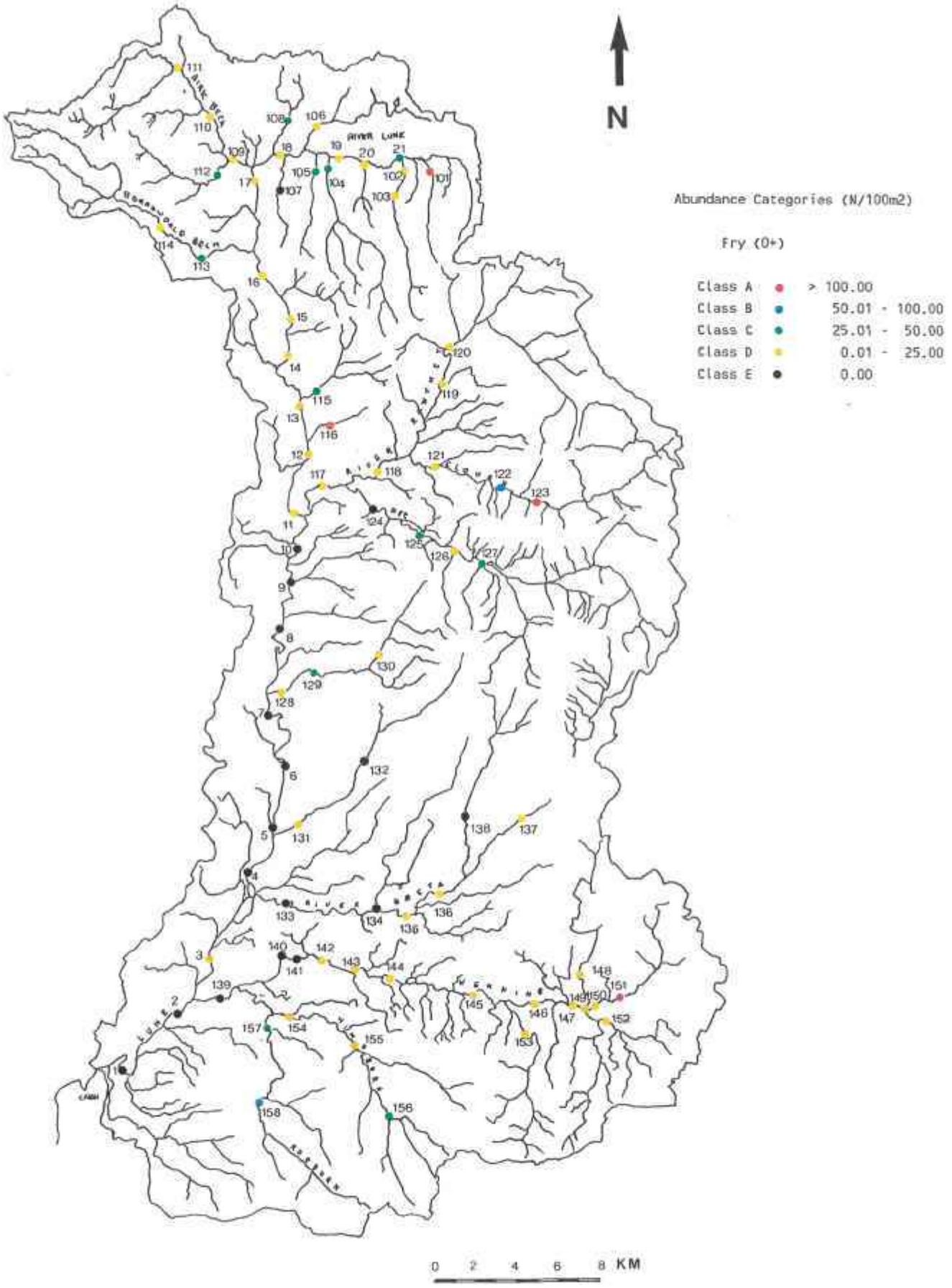
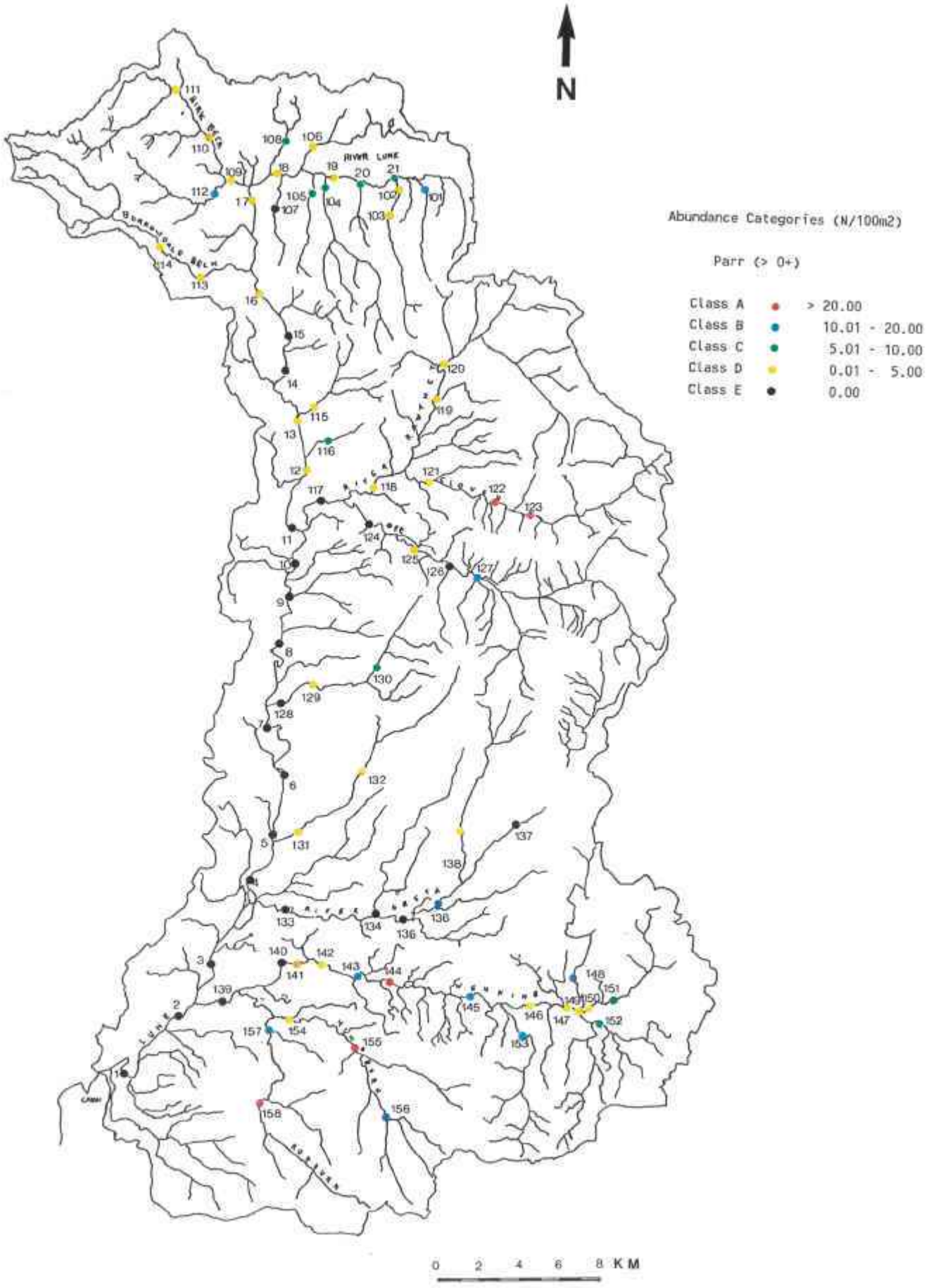


Fig. 16 1+ Trout Densities In The River Lune Catchment 1982



The Hindburn/Roeburn system (subcatchment 13) and the upper Lune and its tributaries (subcatchment 1) were the most productive areas of the catchment (Fig. 17). In the former case 60% of sites were class C and 20% class B (n=5), while in the latter case 33% were class B, and 25% class C (n=12).

There was only one site in the catchment which registered as class A and this was site 151 on Austwick Beck. There was no evidence of any stocking at this site.

### 4.2.6 1+ Trout 1983

As was the case with fry the results show an overall improvement in the higher density categories of class B and C, with a reduction of class E sites and no change in the percentage of class D sites (Figs. 3 and 18).

From the results it would seem that the sites of the main river, particularly those of subcatchments 3 and 4 were not conducive to trout production (52.4% class E and 42.9% class D).

There appeared to be some correlation between the density of parr observed at site 123 on the Clough (class B) and the fact that this area was stocked with fry in 1982.

The highest densities of parr were recorded at sites 122 (Clough) and 116 (Croasdale Beck) which were both class A sites.

### 4.2.7 0+ Trout 1984

1984 was the most productive year of the study period for 0+ trout with 9.2% of the sites sampled being registered as class A, 5.3% class B and 14.5% class C (Figs. 3 and 19).

The Wenning and Hindburn/Roeburn subcatchments (12 and 13) were not as productive as in previous surveys and were dominated by class D sites. The most productive areas tended to be small becks such as Weasdale Beck (site 101), Bowderdale Beck (sites 102 and 103), but it should be noticed that the Clough (subcatchment 8) was also a relatively productive area.

The upper reaches of the Lune was stocked with 7,761 unfed fry along a 1.2km section approximately 0.8km upstream of site 21. In addition to this two tributary sites (Bowderdale Beck 102 and Weasdale Beck 101) were in similar proximity to the stocked zone and all three sites had excellent densities of trout fry (class A). As the exact area of the stocked zone is not known it is difficult to assess whether or not the observed densities were influenced by the stocking.

Chapel Beck was stocked with 4,000 unfed fry just upstream of site 115 and this site was subsequently found to have an excellent density of fry (class A).

Fig. 17 0+ Trout Densities In The River Lune Catchment 1983

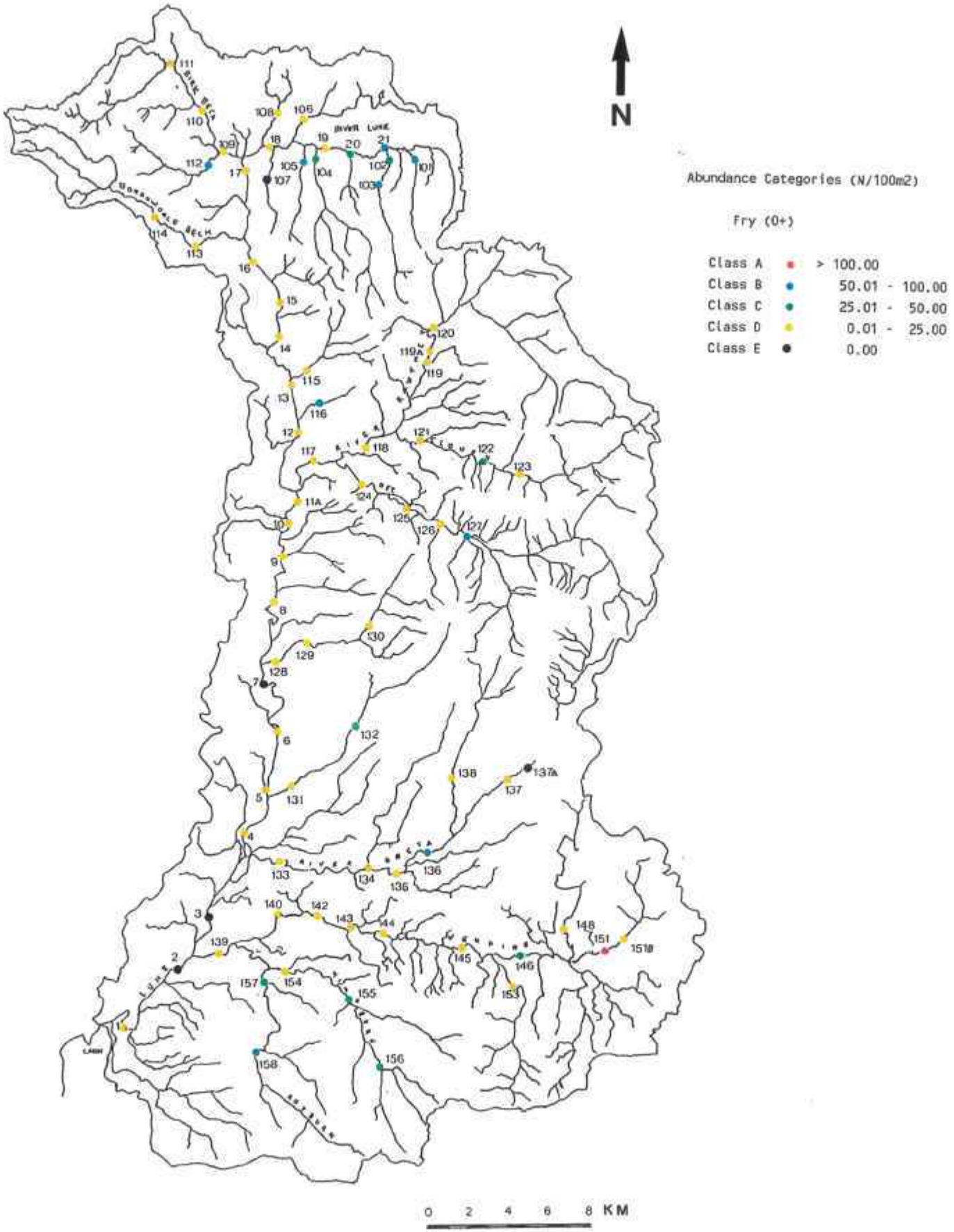


Fig. 18 1+ Trout Densities In The River Lune Catchment 1983

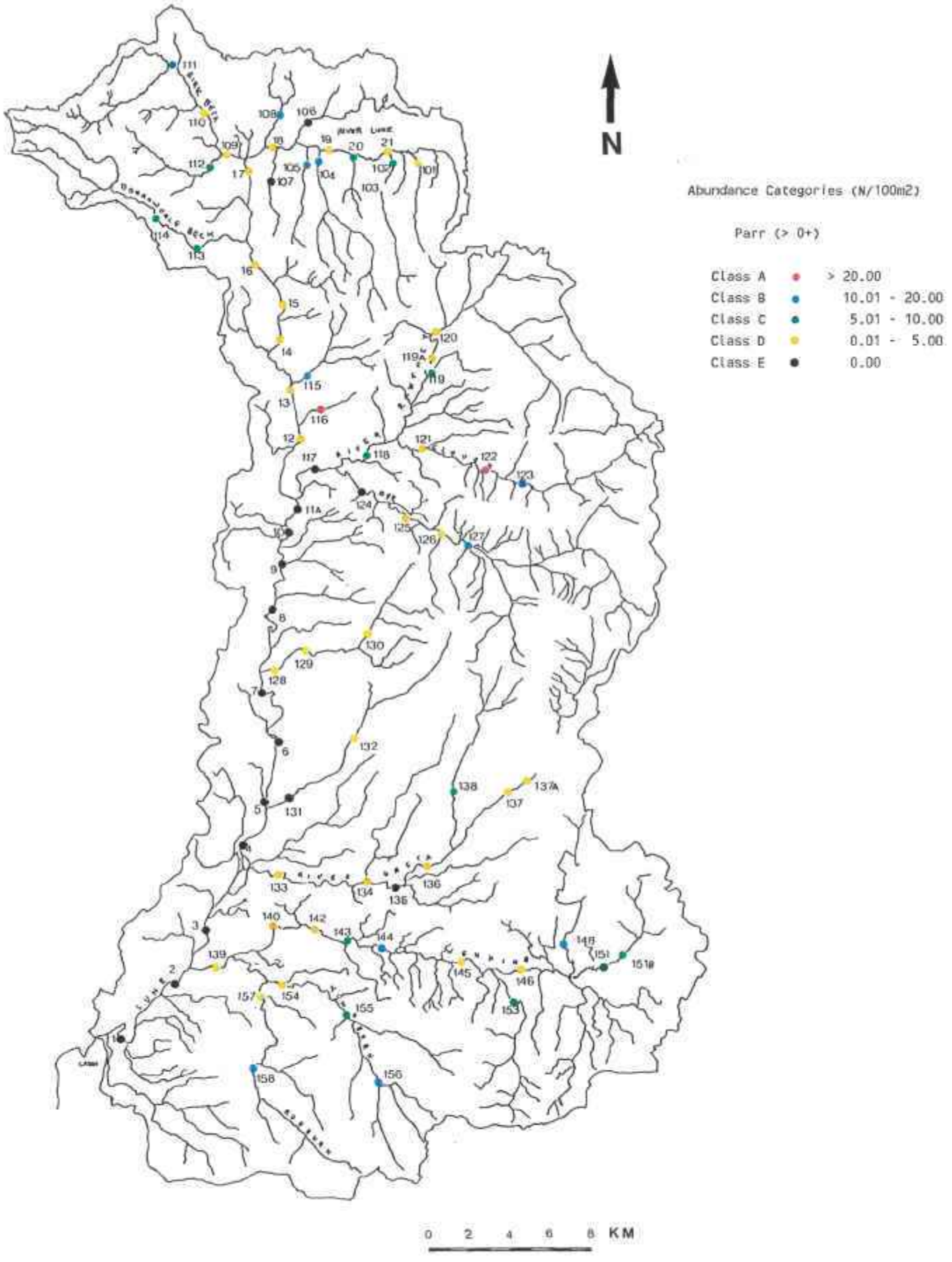
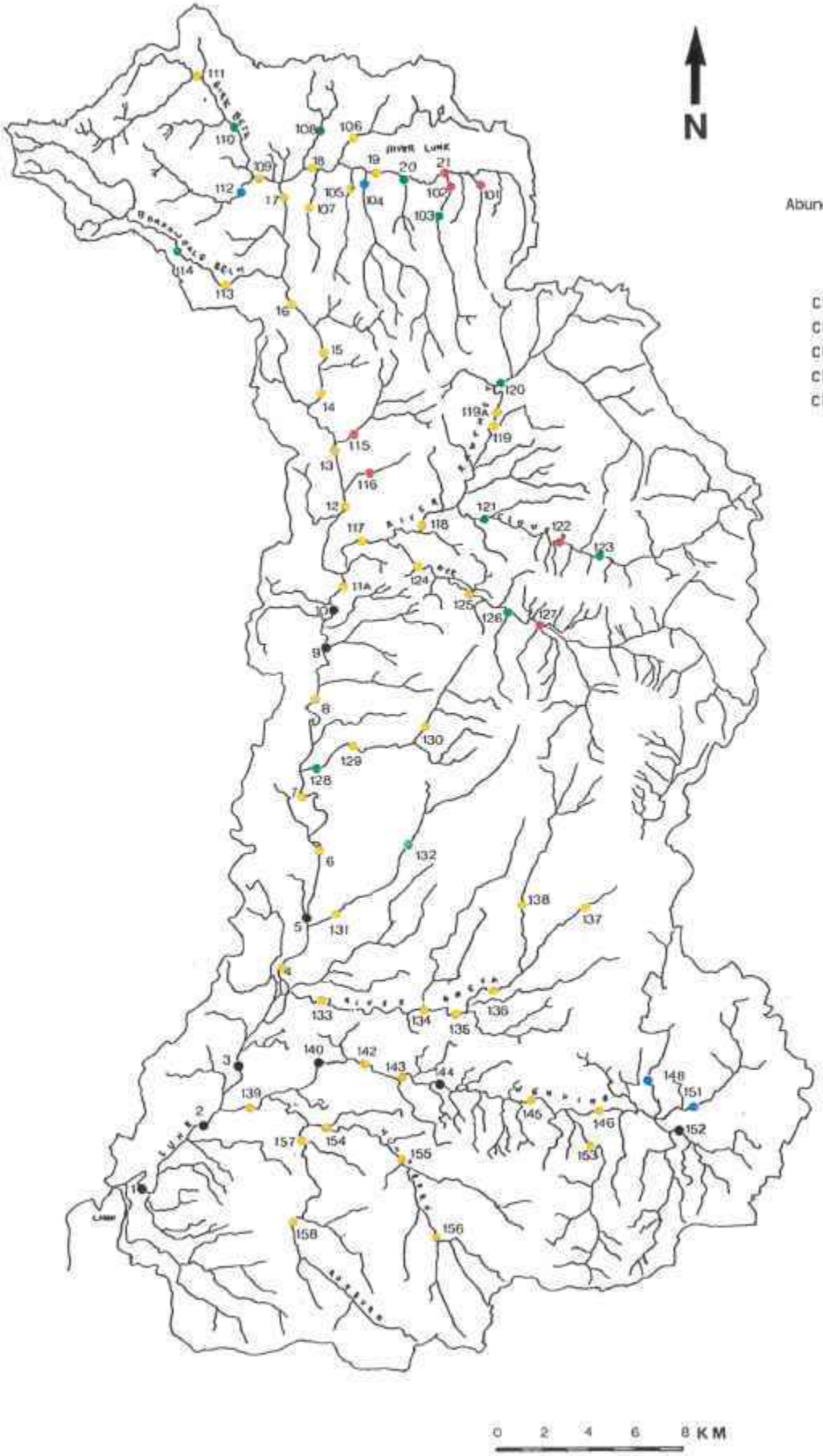


Fig. 19 0+ Trout Densities In The River Lune Catchment 1984



### 4.2.8 1+ Trout 1984

1984 was also the most productive year of the study period for 1+ trout with 13.2% of sites categorised as class B and 10.5% as class A. Fewer sites were categorised as class E (14.5%) than in any of the previous surveys since 1981 (Figs. 3 and 20).

The main river sites were once again relatively unproductive, 61.9% of sites had parr densities less than 5/100m$^2$ (class D) and 38.1% of sites were categorised as class E.

The Clough and Hindburn/Roeburn subcatchments (8 and 13 respectively) were the most productive areas of the Lune catchment followed by Leck Beck (subcatchment 10) and Borrowdale Beck (subcatchment 5).

### 4.2.9 0+ Trout 1985

The Lune catchment as a whole was less productive than in previous years (except for 1981) in respect of the number of sites being classified as A, B and C (Figs. 3 and 21). A large proportion of the sites sampled were class D (72.3%). It was some of the small becks such as Tebay Gill (site 107, class A), Austwick Beck (sites 151 and 152, class B) and Croasdale Beck (site 116, class A) which were the most productive areas of the catchment.

### 4.2.10 1+ Trout 1985

The results of the 1985 survey indicate a reduction in the 1+ productivity of the catchment compared to the three previous years. Although the percentage of sites categorised as class E was the lowest recorded during the 1981 to 1985 period, the proportion of class D sites was greater than at any other time during this period.

The Hindburn/Roeburn system and some of the smaller tributaries such as Croasdale beck (site 116, class A) and Chapel Beck (site 115, class B) were the more productive areas of the catchment (Fig. 22). The good density of parr recorded at the latter site may be associated with the stocking carried out there in 1984.

Fig. 20 1+ Trout Densities In The River Lune Catchment 1984

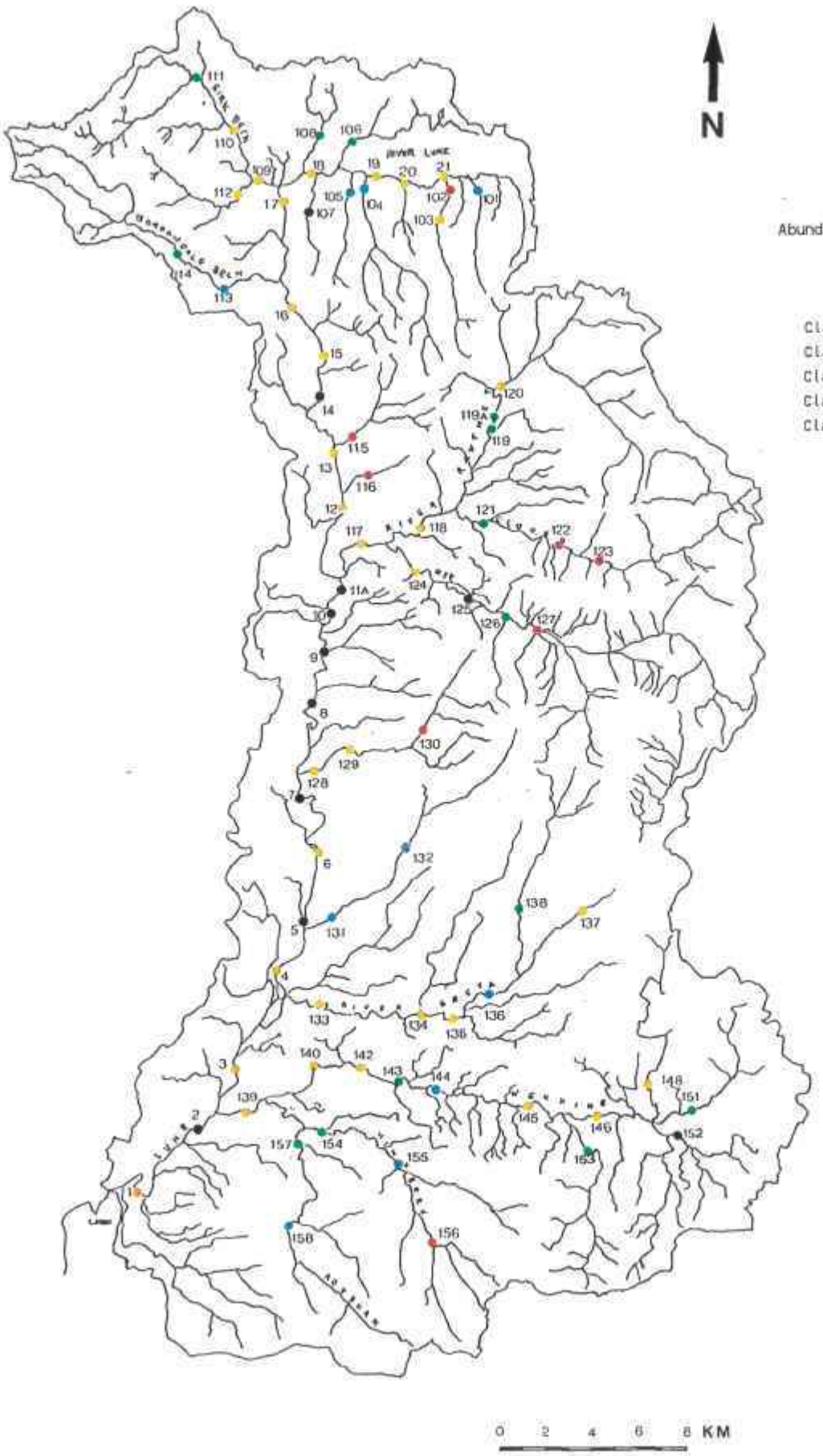


Fig. 21 0+ Trout Densities in The River Lune Catchment 1985

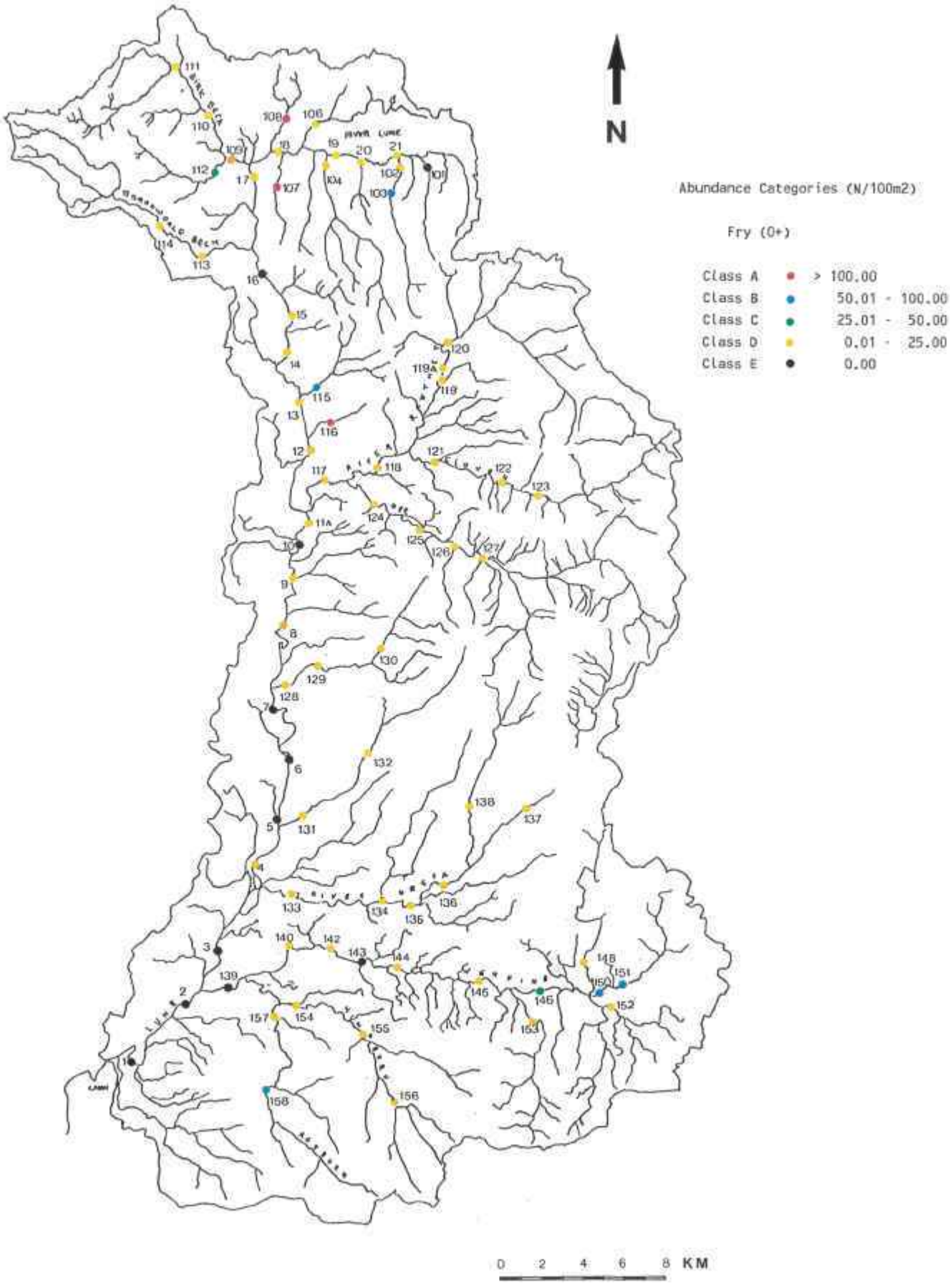
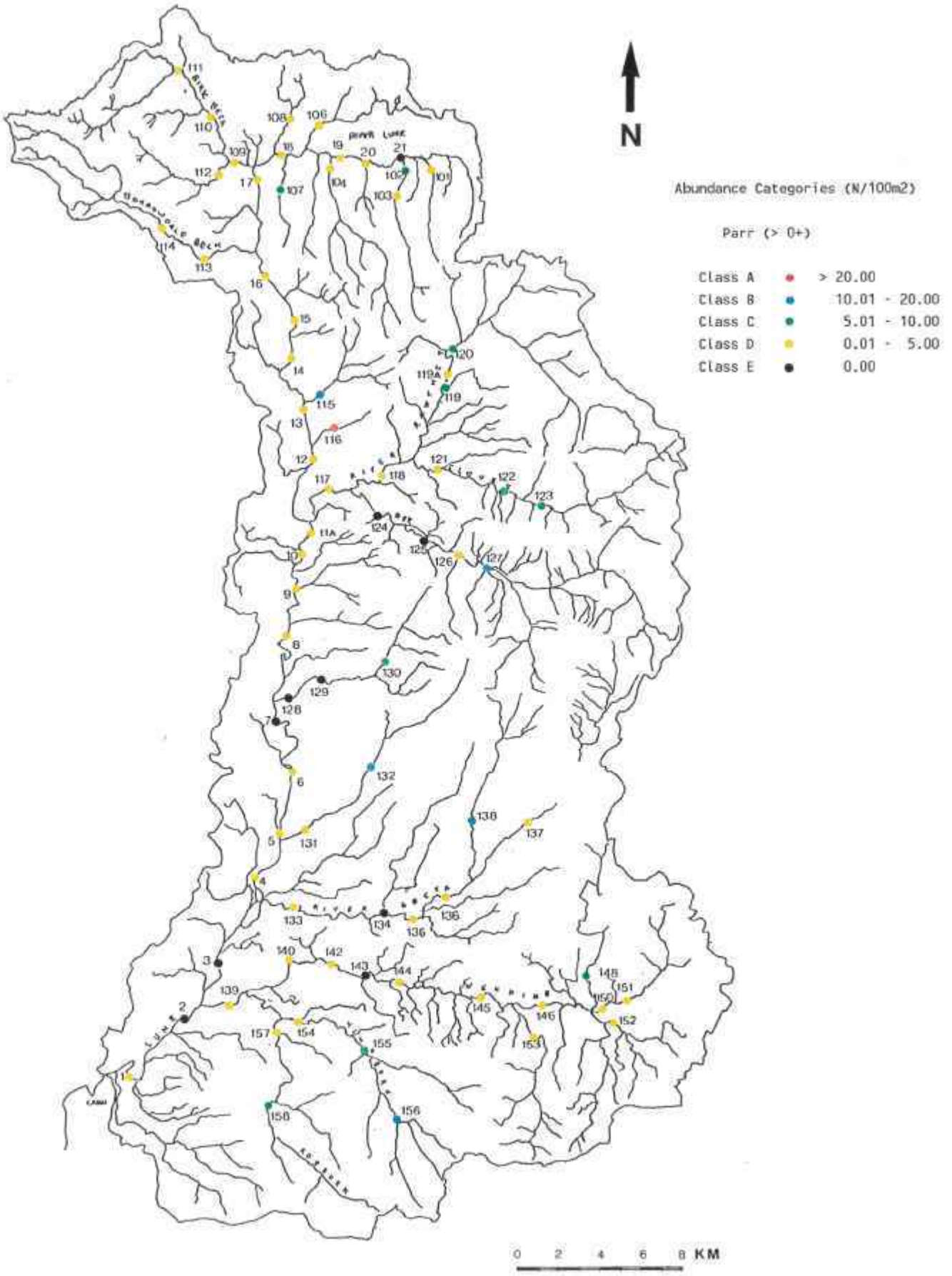


Fig. 22 1+ Trout Densities In The River Lune Catchment 1985



## 4.3 Salmon Population Dynamics Within The 13 Subcatchments

### 4.3.1 Subcatchment 1: The Upper Lune and its Tributaries

In some years there seemed to be a distinction between the density of 0+ salmon at the main Lune sites compared to the tributary sites. Many of the tributary sites had extremely low densities compared to the main river sites. These sites are Chapel Beck (site 108), Rais Beck (site 106), Ellergill Beck (site 105), and Longdale Beck (site 104); Weasdale Beck (site 101) may also be included in this group with respect to the latter years. The exceptions to this are Tebay Gill (site 107) and Bowderdale Beck (site 102 and 103). In fact the highest density of 0+ salmon recorded in the river Lune catchment was 505.6+/-60.3/100m$^2$ (class A) and this was at Tebay Gill which is known to have been heavily stocked over the years.

It is apparent from Table 2 that the best sites in this subcatchment in terms of mean density and CV are Tebay (site 17), Old Tebay Bridge (site 18), Kelleth Bridge (site 20) and Wath (site 21). The mean densities at these sites ranged from 41.7+/-59.3/100m$^2$ to 55.8+/-203.4/100m$^2$ (class C/B) with a coefficient of variance ranging from 38.8% to 59.5%.

1+ salmon densities were highly variable in this subcatchment. The highest density recorded was 70.2+/-12.9/100m$^2$ (class A) at Tebay Gill (site 107) in 1983. Kelleth Bridge (site 20) with a mean density of 15.3+/-13.5/100m$^2$ (class B) and coefficient of variation of 31.5% together with Tebay Gill (site 107) having a mean density of 44.5+/-69.2/100m$^2$ (class A) and coefficient of variance of 76.5% were the best sites in the subcatchment.

### 4.3.2 Subcatchment 2: The Upper Middle Lune System

This was a relatively unproductive catchment for 0+ salmon over the 1981 to 1985 period. Site mean densities were less than 25/100m$^2$ (Table 2). The situation was essentially the same for salmon parr except in 1984 when a relatively good year class was recorded. The most productive site of the catchment was site 16 (Yorkshire Bridge) with a mean density of 11.8/100m$^2$ (class B) and a coefficient of variation of 109.9%.

### 4.3.3 Subcatchment 3: The Lower Middle Lune System

The 0+ salmon abundance characteristics of this subcatchment were comparable to that of subcatchment 2. Mean densities were low (class D) and the associated CV high (Table 2). A similar situation was observed for 1+ salmon where site mean densities were also low (class D) (Table 3).

Table 2. Mean Densities and Coefficient of Variation (CV) for 0+ Salmon

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 1 | 17 | Tebay | 42.7 | 43.01 | C |
| | 18 | Old Tebay Br. | 52.2 | 59.49 | B |
| | 19 | Rayne Br. | 55.8 | 44.16 | B |
| | 20 | Kelleth Br. | 43.8 | 38.77 | C |
| | 21 | Wath | 41.7 | 59.31 | C |
| | 101 | Weasdale B. | 10.7 | 194.87 | D |
| | 102 | Bowderdale B. | 23.6 | 33.27 | D |
| | 103 | Bowderdale B. | 61.4 | 123.75 | B |
| | 104 | Longdale B. | 2.7 | 124.67 | D |
| | 105 | Ellergill B. | 1.6 | 175.11 | D |
| | 106 | Rais B. | 0.2 | 487.34 | D |
| | 107 | Tebay Gill | 247.0 | 101.67 | A |
| | 108 | Chapel B. | 0.4 | 264.58 | D |
| 2 | 11 | 4 Lane Ends | 6.3 | - | D |
| | 11A | Park Wood | 23.0 | 144.39 | D |
| | 12 | Lincoln Inn | 14.6 | 22.80 | D |
| | 13 | Thwaites | 14.9 | 82.06 | D |
| | 14 | Fleetholme | 1.0 | 133.79 | D |
| | 15 | Fairmile | 0.3 | 129.10 | D |
| | 16 | Yorkshire Br. | 11.8 | 96.69 | D |
| 3 | 6 | Kirkby Lonsdale | 16.9 | 272.40 | D |
| | 7 | Linderlay | 20.6 | 118.31 | D |
| | 8 | Rigmaden | 5.1 | 72.15 | D |
| | 9 | Middleton | 7.3 | 114.85 | D |
| | 10 | HallBeck | 8.3 | 83.34 | D |
| 4 | 1 | Caton | 11.2 | 131.87 | D |
| | 2 | Snab | 3.7 | 93.39 | D |
| | 3 | Gressingham | 17.6 | 137.71 | D |
| | 4 | Newton | 30.3 | 84.67 | C |
| | 5 | Whittington | 21.3 | 62.45 | D |
| 5 | 109 | Birk B. | 32.7 | 135.81 | C |
| | 110 | Birk B. | 9.5 | 50.77 | D |
| | 111 | Birk B. | 6.8 | 111.58 | D |
| | 112 | Bretherdale B. | 30.0 | 60.25 | C |
| | 113 | Borrowdale B. | 38.0 | 132.22 | C |
| | 114 | Borrowdale B. | 27.0 | 137.29 | C |
| 6 | 115 | Chapel B. | 66.8 | 60.02 | B |
| | 116 | Croasdale B. | 54.6 | 272 74 | B |
| 7 | 117 | Ingmire | 32.5 | 60.81 | C |
| | 118 | Sedbergh | 39.9 | 96.95 | C |
| | 119 | Burnt Mill | 15.5 | 102.33 | D |
| | 119A | Cautley | 27.2 | 25.08 | C |
| | 120 | Rawthey | 10.7 | 88.89 | D |
| 8 | 121 | Clough | 7.5 | 124.27 | D |
| | 122 | Clough | 0.2 | 312.25 | D |
| | 123 | Clough | 2.9 | 515.91 | D |

Table 2. (Cont.)

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 9 | 124 | Dee | 14.7 | 70.26 | D |
| | 125 | Dee | 51.0 | 47.04 | B |
| | 126 | Dee | 19.7 | 362.83 | D |
| | 127 | Dee | 2.8 | 140.97 | D |
| 10 | 128 | Barbon B. | 98.1 | 124.25 | B |
| | 129 | Barbon B. | 66.7 | 54.98 | B |
| | 130 | Barbon B. | 20.9 | 135.79 | D |
| | 131 | Leck B. | 23.4 | 112 15 | D |
| | 132 | Leck B. | 14.5 | 110.66 | D |
| 11 | 133 | Greta | 16.2 | 155.41 | D |
| | 134 | Greta | 14.0 | 59.62 | D |
| | 135 | Greta | 21.6 | 68.02 | D |
| | 136 | Greta | 13.3 | 47.90 | D |
| | 137 | Doe | 0.0 | - | E |
| | 137A | Doe | 0.0 | - | E |
| | 138 | Greta | 0.0 | - | E |
| 12 | 139 | Wenning | 12.3 | 185.00 | D |
| | 140 | Wenning | 1.7 | 381.63 | D |
| | 141 | Wenning | 4.3 | - | D |
| | 142 | Wenning | 0.0 | - | E |
| | 143 | Wenning | 0.0 | - | E |
| | 144 | Wenning | 0.2 | 364.01 | E |
| | 145 | Wenning | 7.7 | 63.30 | E |
| | 146 | Wenning | 24.6 | 228.84 | D |
| | 147 | Wenning | 0.0 | - | E |
| | 148 | Clapham B. | 0.5 | 100.00 | D |
| | 149 | Austwick B. | 0.0 | - | E |
| | 150 | Austwick B. | 13.8 | - | D |
| | 151 | Austwick B. | 12.3 | 100.44 | D |
| | 151B | Austwick B. | 0.3 | - | D |
| | 152 | Fen B. | 2.3 | 127.58 | D |
| | 153 | Keasden B. | 0.0 | - | E |
| 13 | 154 | Hindburn | 2.8 | 453.43 | D |
| | 155 | Hindburn | 0.0 | - | E |
| | 156 | Hindburn | 0.0 | - | E |
| | 157 | Roeburn | 5.3 | 260.68 | D |
| | 158 | Roeburn | 0.0 | - | E |

Table 3. Mean Densities and Coefficient of Variation (CV) for 1+ Salmon

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 1 | 17 | Tebay | 1.63 | 92.43 | D |
| | 18 | Old Tebay Br. | 4.96 | 47.67 | D |
| | 19 | Rayne Br. | 9.69 | 106.11 | C |
| | 20 | Kelleth Br. | 15.27 | 31.46 | B |
| | 21 | Wath | 6.40 | 101.15 | C |
| | 101 | Weasdale B. | 10.50 | 194.87 | B |
| | 102 | Bowderdale B. | 12.77 | 74.48 | B |
| | 103 | Bowderdale B. | 9.41 | 104.05 | C |
| | 104 | Longdale B. | 12.68 | 227.53 | B |
| | 105 | Ellergill B. | 18.78 | 120.53 | B |
| | 106 | Rais B. | 5.09 | 107.14 | C |
| | 107 | Tebay Gill | 44.53 | 76.51 | A |
| | 108 | Chapel B. | 5.16 | 66.60 | C |
| 2 | 11 | 4 Lane Ends | 0.25 | - | D |
| | 11A | Park Wood | 1.43 | 162.65 | D |
| | 12 | Lincoln Inn | 7.69 | 97.27 | C |
| | 13 | Thwaites | 6.85 | 83.89 | C |
| | 14 | Fleetholme | 2.58 | 103.71 | D |
| | 15 | Fairmile | 2.87 | 47.65 | D |
| | 16 | Yorkshire Br. | 11.07 | 109.89 | B |
| 3 | 6 | Kirkby Lonsdale | 3.56 | 69.60 | D |
| | 7 | Linderlay | 0.67 | 73.12 | D |
| | 8 | Rigmaden | 1.78 | 147.57 | D |
| | 9 | Middleton | 1.63 | 44.24 | D |
| | 10 | HallBeck | 2.73 | 174.48 | D |
| 4 | 1 | Caton | 0.32 | 146.58 | D |
| | 2 | Snab | 0.17 | 176.47 | D |
| | 3 | Gressingham | 0.0 | - | E |
| | 4 | Newton | 2.23 | 113.00 | D |
| | 5 | Whittington | 0.54 | 47.57 | D |
| 5 | 109 | Birk B. | 5.90 | 57.43 | C |
| | 110 | Birk B. | 7.52 | 39.87 | C |
| | 111 | Birk B. | 13.57 | 128.66 | B |
| | 112 | Bretherdale B. | 7.64 | 69.37 | C |
| | 113 | Borrowdale B. | 12.40 | 13.83 | B |
| | 114 | Borrowdale B. | 18.00 | 28.96 | B |
| 6 | 115 | Chapel B. | 16.00 | 125.34 | B |
| | 116 | Croasdale B. | 18.75 | 102.29 | B |
| 7 | 117 | Ingmire | 4.49 | 61.03 | D |
| | 118 | Sedbergh | 21.79 | 70.09 | A |
| | 119 | Burnt Mill | 6.62 | 86.80 | C |
| | 119A | Cautley | 3.66 | 42.68 | D |
| | 120 | Rawthey | 3.59 | 115.83 | D |
| 8 | 121 | Clough | 6.08 | 34.22 | C |
| | 122 | Clough | 0.65 | 239.33 | D |
| | 123 | Clough | 1.31 | 138.04 | D |

Table 3. (Cont.)

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 9 | 124 | Dee | 7.02 | 90.69 | C |
| | 125 | Dee | 2.89 | 89.30 | D |
| | 126 | Dee | 3.83 | 74.86 | D |
| | 127 | Dee | 5.77 | 67.08 | C |
| 10 | 128 | Barbon B. | 5.92 | 34.58 | C |
| | 129 | Barbon B. | 8.65 | 94.36 | C |
| | 130 | Barbon B. | 19.77 | 61.32 | B |
| | 131 | Leck B. | 11.05 | 151.83 | B |
| | 132 | Leck B. | 11.85 | 42.57 | B |
| 11 | 133 | Greta | 4.20 | 176.64 | D |
| | 134 | Greta | 1.89 | 355.05 | D |
| | 135 | Greta | 11.23 | 106.90 | B |
| | 136 | Greta | 10.22 | 71.56 | B |
| | 137 | Doe | 0.0 | - | E |
| | 137A | Doe | 0.0 | - | E |
| | 138 | Greta | 0.22 | 213.20 | D |
| 12 | 139 | Wenning | 4.49 | 107.94 | D |
| | 140 | Wenning | 0.21 | 212.96 | D |
| | 141 | Wenning | 0.0 | - | E |
| | 142 | Wenning | 0.05 | 191.52 | D |
| | 143 | Wenning | 0.39 | 120.27 | D |
| | 144 | Wenning | 2.05 | 161.05 | D |
| | 145 | Wenning | 2.57 | 66.94 | D |
| | 146 | Wenning | 0.99 | 102.51 | D |
| | 147 | Wenning | 0.0 | - | E |
| | 148 | Clapham B. | 3.37 | 46.92 | D |
| | 149 | Austwick B. | 0.0 | - | E |
| | 150 | Austwick B. | 0.79 | 28.30 | D |
| | 151 | Austwick B. | 0.79 | 175.40 | D |
| | 151B | Austwick B. | 0.85 | - | D |
| | 152 | Fen B. | 0.0 | - | E |
| | 153 | Keasden B. | 0.0 | - | E |
| 13 | 154 | Hindburn | 1.55 | 126.43 | D |
| | 155 | Hindburn | 0.0 | - | E |
| | 156 | Hindburn | 0.0 | - | E |
| | 157 | Roeburn | 2.62 | 139.67 | D |
| | 158 | Roeburn | 0.09 | 193.97 | D |

### 4.3.4 Subcatchment 4: The Lower Lune System

Mean densities for 0+ salmon in this subcatchment ranged from class D to C with the most productive site being Newton (site 4). The mean density at this site for the period 1981 to 1985 was 30.3+/-114.8/100m$^2$ (class C). In contrast mean densities of 1+ salmon were extremely low (<3/100m$^2$, class D).

### 4.3.5 Subcatchment 5: The Birk Beck/Borrowdale Beck System

The results show mean densities of salmon fry to vary between class D and class C with relatively high coefficient of variation (Table 2). Site 112 on Bretherdale Beck with a mean of 30+/-71.5/100m$^2$ and a CV of 60.3% was the site which displayed the least amount of variation about the mean for a class C site.

This was a very good subcatchment for 1+ salmon production. The sites with the highest mean density and lowest CV were found to be site 113 (12.5+/-18.7/100m$^2$, 13.8%) and 114 (18+/-18.1/100m$^2$, 28.9%) on Borrowdale Beck (both class B). Site 113 showed the least variability about the mean of any site in the Lune catchment with respect to 1+ salmon (Table 3).

### 4.3.6 Subcatchment 6: The Chapel Beck/Croasdale Beck System

Site 116 on Croasdale Beck proved to be a highly variable site for 0+ salmon production, being categorised as class A in 1982 and class D in the following years to 1985. The CV for this site was 272.7% indicating a high degree of variation about the mean (54.6+/-300.3/100m$^2$). Site 115 (Chapel Beck) was less variable and produced good year classes in 1983 and 1984 (class B) and was evidently one of the best sites in the Lune catchment having a mean density of 66.8+/-100.7/100m$^2$ (class B) and a CV of 60%.

Mean densities of 1+ salmon at sites 115 (Chapel Beck) and 116 (Croasdale Beck) registered as class B and the associated CV was found to be 125.3% and 102.3% respectively.

### 4.3.7 Subcatchment 7: The Rawthey System

0+ salmon densities in this subcatchment were dominated by those sites registering as class C and D. The only exception was at Sedbergh (site 118) where densities of class A and B were recorded in 1983 and 1984 respectively. Table 2 shows that in terms of mean site density and variation about the mean, site 119a (Cautley) and 117 (Ingmire) were the best sites for 0+ salmon production in this subcatchment (both class C). The mean density at site 118 (Sedbergh) was comparable to the former sites but the CV was higher.

Site mean densities of 1+ salmon in this subcatchment were generally low (class C to D) with the exception of site 118

(Sedbergh) where a mean density of 21.8+/-44.2/100m$^2$ (class A) was found with a CV of 70.1%.

### 4.3.8 Subcatchment 8: The Clough System

0+ salmon were not recorded from this subcatchment in 1981 and were present at very low densities between 1982 and 1985 (mainly class D and E). Site mean densities were very low (class D) with high CV (Table 2).

Similarly, 1+ salmon densities were low, two of the three sites sampled had mean densities registering as class D (Table 3).

### 4.3.9 Subcatchment 9: The Dee System

0+ salmon densities in this system were generally low (class D and E). There were however some notable exceptions such as the strong year class produced at site 126 in 1982 (class A) and at site 125 in 1984 and 1985 (class B). Table 2 shows that in terms of site mean densities and CV this subcatchment yielded low densities with relatively high variation about the mean. However, site 125 is clearly the exception ranking as one of the best sites in the Lune catchment (class B, CV = 47%).

Sites 124 and 127 were the most productive of this subcatchment with respect to 1+ salmon (mean densities registering as class C with maximum densities of class B).

There are no significant obstacles to migratory fish in this subcatchment although it is known that certain areas of the river are liable to dry up during the summer months upstream of sites 126 (A. Atkinson pers. comm.). Such drought conditions may impact on salmonid production by reducing the available habitat for fry and parr in addition to reducing cover and dissolved oxygen concentration with increased temperature effects.

### 4.3.10 Subcatchment 10: The Barbon Beck/Leck Beck System

The most significant feature of this subcatchment were sites 128 and 129 on Barbon Beck which produced very strong year classes of 0+ salmon during the period 1982 to 1985. The highest density was recorded at site 128 in 1984 (279.9+/-32.4/100m$^2$, class A). Mean densities at these sites registered as class B (Table 2). Barbon Beck 130 was considerably less productive than these sites and with the exception of the 1983 year class (class B) site densities ranged from class D to E. This site cannot produce self sustaining salmon populations as a result of the impassable waterfall downstream of the site. The presence of juvenile salmon at this site is due to stocking.

Sites 131 and 132 on Leck Beck had mean densities of 0+ salmon which registered as class D (Table 2); maximum densities of

class B (site 131) and class C (site 132) were recorded for both sites in 1983.

The densities of 1+ salmon at sites 128 and 129 on Barbon Beck were considerably less than expected in view of the very strong 0+ year classes at these sites, mean densities registered as class C. High densities were achieved on two occasions, in 1982 (site 128, class B) and 1984 (site 129, class A). The most productive site was in fact site 130 yielding class A densities in 1981, 1982 and 1984.

Parr production at the Leck Beck sites (131 and 132) was greater than expected from the level of 0+ productivity at these sites; mean densities registered as class B (Table 3). A peak density of 43.3+/-9.3/100m$^2$ (class A) was recorded in 1984.

Site 130 on Barbon Beck and 132 on Leck Beck were found to be the most productive sites in the subcatchment for 1+ salmon with mean densities of 19.8+/-46.3/100m$^2$ and 11.9+/-19.9/100m$^2$ (both class B) and CV of 61.3% and 42.6% respectively.

### 4.3.11 Subcatchment 11: The Greta System

0+ salmon densities varied between absent and moderate (class E to C) with mean densities registering as class D/E (Table 2). No fry were recorded at sites 137, 137a and 138 probably as a result of the presence of waterfalls impeding the upstream movement of adults.

1+ salmon densities were similarly partitioned between sites 133, 134, 135, 136 which ranged from class A to E and sites 137, 137a, 138 which were all class E except for site 138 in 1983 (class D). The most productive sites of this subcatchment were sites 135 and 136 having mean densities of 11.2+/-29.8/100m$^2$ and 10.2+/-21.4/100m$^2$ (both class B) and CV of 106.9% and 71.6% respectively.

### 4.3.12 Subcatchment 12: The Wenning System

0+ salmon production at the River Wenning was generally very low, the majority of sites were categorised as class D and E and no fry were recorded at sites 142 and 143 during the study period. As a consequence, mean densities were also very low (class D and E) and in addition the degree of variation about the mean was high (Table 2). One of the most striking features of the results in the context of the low productivity of the subcatchment was the very strong year class of fry produced at site 146 in 1985 (class A). There was no record of any stocking having taken place.

The sites at the head waters of the river Wenning (site 152 on Fen Beck, sites 149, 150, 151 and 151b on Austwick Beck, site 148 on Clapham Beck and site 153 on Keasden Beck) were also characterised by very low densities (class C to E). No salmon

fry were recorded at site 153 on Keasden Beck on each of the sampling occasions.

1+ salmon production was very low in this subcatchment. Of the 54 sampling occasions, the 16 sites of this system were classified as class D and E for 90.7% of the time.

These results indicate the Wenning system to be unproductive for salmon. The reasons for this may be related to the presence of instream obstructions and the availability of suitable habitat.

### 4.3.13 Subcatchment 13: The Hindburn/Roeburn System

0+ salmon densities in this subcatchment were extremely low with no fry being recorded in 1984. The most productive sites were 154 on the Hindburn and 157 on the Roeburn which were categorised as class D (based on mean values) though densities did reach as high as class C in 1981.

This pattern of abundance was also reflected by the 1+ salmon densities which were predominantly class D and E. Site 157 on the Roeburn was the most productive site being categorised as class C in 1982 and 1983, but based on the site mean density over the 1981 to 1985 period this was a class D site.

## 4.4 Trout Population Dynamics Within The 13 Subcatchments

### 4.4.1 Subcatchment 1: The Upper Lune and its Tributaries

The results show that this subcatchment is one of the most productive for 0+ trout (Table 4). Site 101 on Weasdale Beck was the most productive site of the subcatchment with a mean site density of 113.9+/-216.6/100$m^2$ (class A) and a CV of 90.5%. The CV was relatively high because of the fact that no fry were recorded at this site in 1985 although densities had been very good in the previous years. Site 105 on Ellergill Beck and site 107 on Tebay Gill had mean site densities which registered as class B, however in the latter case there was a high degree of variation about the mean (CV of 288.2% compared to 51.6% in the former case). 0+ densities at site 107 were less than 3/100$m^2$ between 1982 to 1984 but the exceptionally high densities in 1985 (361.2+/-147.3/100$m^2$) resulted in a high mean site density. The main river sites 17 (Tebay), 18 (Old Tebay Bridge) and 19 (Rayne Bridge) together with site 106 on Rais Beck yielded particularly low densities of fry and registered as class D (based on mean site densities and maximum densities). The remaining sites in the subcatchment had mean site densities which registered as class C.

The becks in this system, although highly variable, were on the whole much better 0+ trout producing waters than the main river sites. The only exception was Rais Beck (site 106) which is known to be susceptible to organic enrichment (Saxby, 1991). This difference in densities between the becks and main

Table 4. Mean Densities and Coefficient of Variation (CV) for 0+ Trout

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 1 | 17 | Tebay | 1.9 | 124.99 | D |
| | 18 | Old Tebay Br. | 5.9 | 84.54 | D |
| | 19 | Rayne Br. | 6.8 | 101.27 | D |
| | 20 | Kelleth Br. | 32.3 | 15.10 | C |
| | 21 | Wath | 34.5 | 134.78 | C |
| | 101 | Weasdale B. | 114.0 | 90.46 | A |
| | 102 | Bowderdale B. | 41.5 | 155.69 | C |
| | 103 | Bowderdale B. | 43.4 | 52.61 | C |
| | 104 | Longdale B. | 42.9 | 73.76 | C |
| | 105 | Ellergill B. | 67.1 | 51.61 | B |
| | 106 | Rais B. | 2.6 | 164.17 | D |
| | 107 | Tebay Gill | 63.5 | 288.17 | B |
| | 108 | Chapel B. | 42.5 | 109.05 | C |
| 2 | 11 | 4 Lane Ends | 0.3 | - | D |
| | 11A | Park Wood | 0.9 | - | D |
| | 12 | Lincoln Inn | 6.7 | 213.24 | D |
| | 13 | Thwaites | 6.1 | - | D |
| | 14 | Fleetholme | 0.3 | 388.73 | D |
| | 15 | Fairmile | 0.5 | 181.11 | D |
| | 16 | Yorkshire Br. | 1.3 | 128.49 | D |
| 3 | 6 | Kirkby Lonsdale | 0.0 | - | E |
| | 7 | Linderlay | 0.0 | - | E |
| | 8 | Rigmaden | 0.2 | 70.71 | D |
| | 9 | Middleton | 0.0 | - | E |
| | 10 | HallBeck | 0.0 | - | E |
| 4 | 1 | Caton | 0.0 | - | E |
| | 2 | Snab | 0.0 | - | E |
| | 3 | Gressingham | 0.0 | - | E |
| | 4 | Newton | 0.1 | 200.00 | D |
| | 5 | Whittington | 0.0 | - | E |
| 5 | 109 | Birk B. | 16.4 | 58.21 | D |
| | 110 | Birk B. | 15.2 | 106.77 | D |
| | 111 | Birk B. | 4.1 | 80.86 | D |
| | 112 | Bretherdale B. | 46.4 | 32.25 | C |
| | 113 | Borrowdale B. | 20.7 | 58.12 | D |
| | 114 | Borrowdale B. | 33.2 | 43.00 | C |
| 6 | 115 | Chapel B. | 56.8 | 76.75 | B |
| | 116 | Croasdale B. | 426.6 | 17.88 | A |
| 7 | 117 | Ingmire | 0.9 | 144.44 | D |
| | 118 | Sedbergh | 4.5 | 71.97 | D |
| | 119 | Burnt Mill | 6.5 | 70.72 | D |
| | 119A | Cautley | 6.9 | 60.61 | D |
| | 120 | Rawthey | 24.0 | 28.29 | D |
| 8 | 121 | Clough | 12.5 | 166.07 | D |
| | 122 | Clough | 25.3 | 221.16 | C |
| | 123 | Clough | 22.6 | 212.92 | D |

Table 4. (Cont.)

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 9 | 124 | Dee | 4.0 | 140.00 | D |
| | 125 | Dee | 13.5 | 87.63 | D |
| | 126 | Dee | 17.8 | 66.94 | D |
| | 127 | Dee | 47.2 | 88.64 | C |
| 10 | 128 | Barbon B. | 12.1 | 99.36 | D |
| | 129 | Barbon B. | 15.8 | 57.80 | D |
| | 130 | Barbon B. | 2.1 | 125.72 | D |
| | 131 | Leck B. | 11.2 | 73.93 | D |
| | 132 | Leck B. | 33.2 | 81.40 | C |
| 11 | 133 | Greta | 0.9 | 114.93 | D |
| | 134 | Greta | 1.2 | 97.89 | D |
| | 135 | Greta | 2.7 | 107.28 | D |
| | 136 | Greta | 29.3 | 139.02 | C |
| | 137 | Doe | 1.7 | 26.96 | D |
| | 137A | Doe | 0.0 | - | E |
| | 138 | Greta | 7.5 | 105.11 | D |
| 12 | 139 | Wenning | 0.1 | 90.00 | D |
| | 140 | Wenning | 0.5 | 166.13 | D |
| | 141 | Wenning | 0.0 | - | E |
| | 142 | Wenning | 2.1 | 156.71 | D |
| | 143 | Wenning | 1.4 | 153.36 | D |
| | 144 | Wenning | 7.4 | 121.73 | D |
| | 145 | Wenning | 8.0 | 72.35 | D |
| | 146 | Wenning | 17.7 | 76.12 | D |
| | 147 | Wenning | 0.0 | - | D |
| | 148 | Clapham B. | 22.6 | 119.83 | D |
| | 149 | Austwick B. | 0.0 | - | E |
| | 150 | Austwick B. | 50.0 | 112.62 | C |
| | 151 | Austwick B. | 138.7 | 48.28 | A |
| | 151B | Austwick B. | 12.8 | - | D |
| | 152 | Fen B. | 8.5 | 218.16 | D |
| | 153 | Keasden B. | 9.7 | 113.65 | D |
| 13 | 154 | Hindburn | 3.1 | 134.56 | D |
| | 155 | Hindburn | 14.3 | 94.19 | D |
| | 156 | Hindburn | 24.8 | 97.76 | D |
| | 157 | Roeburn | 12.7 | 106.02 | D |
| | 158 | Roeburn | 36.2 | 96.46 | C |

river is opposite to that recorded for 0+ salmon suggesting that nursery areas for the two species in this subcatchment may be partitioned.

The abundance of trout parr followed a similar pattern to that of trout fry with the sites on the tributaries tending to be more productive than the main river sites. According to mean site densities most of the sites on the tributaries, with the exception of site 106 (Rais Beck) and 107 (Tebay Gill), were categorised as class C (Table 5). The most productive site was on Ellergill Beck (site 105) having a mean density of 11.7+/-15.3/100m$^2$ (class B) and a low CV (31.3%). The main river sites 17 (Tebay), 18 (Old Tebay Bridge), 19 (Rayne Bridge), 20 (Kelleth Bridge) and 21 (Wath) all had mean site densities which registered as class D.

### 4.4.2 Subcatchment 2: The Upper Middle Lune System

This subcatchment was considerably less productive for 0+ trout than subcatchment 1 with mean site densities < 7/100m$^2$ and a peak density of 19.3+/-3.2/100m$^2$ (class D) at site 12 (Lincoln Inn) in 1983. As a consequence the whole subcatchment was categorised as class D.

1+ densities were also very low with all sites registering as class D/E.

### 4.4.3 Subcatchment 3: The Lower Middle Lune System

Virtually no trout fry were caught in this subcatchment during the study period. Where fry were present densities did not exceed 0.5/100m$^2$ (class D).

The situation was exactly the same for 1+ trout.

### 4.4.4 Subcatchment 4: The Lower Lune System

This was found to be a very unproductive system. At those sites where fry were present densities did not exceed 1/100m$^2$ (class D).

Similarly, 1+ trout were scarce, none being caught between 1981 and 1983. During 1984 and 1985 densities did not exceed 0.5/100m$^2$ (class D).

### 4.4.5 Subcatchment 5: The Birk Beck/Borrowdale Beck System

Mean site densities of 0+ trout were low at most of the sites (registering as class D, Table 4). Site 112 on Bretherdale Beck and 114 on Borrowdale Beck were the most productive sites with mean site densities of 46.4+/-103.4/100m$^2$ and 33.2+/-106.4/100m$^2$ (both class C) and low CV (32.3% and 43% respectively).

Table 5. Mean Densities and Coefficient of Variation (CV) for 1+ Trout

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 1 | 17 | Tebay | 1.57 | 39.26 | D |
| | 18 | Old Tebay Br. | 0.73 | 68.49 | D |
| | 19 | Rayne Br. | 1.16 | 104.88 | D |
| | 20 | Kelleth Br. | 3.38 | 76.81 | D |
| | 21 | Wath | 2.72 | 110.42 | D |
| | 101 | Weasdale B. | 6.72 | 89.98 | C |
| | 102 | Bowderdale B. | 9.01 | 105.32 | C |
| | 103 | Bowderdale B. | 5.20 | 107.71 | C |
| | 104 | Longdale B. | 5.18 | 134.93 | C |
| | 105 | Ellergill B. | 11.68 | 31.28 | B |
| | 106 | Rais B. | 2.06 | 192.28 | D |
| | 107 | Tebay Gill | 0.94 | 291.54 | D |
| | 108 | Chapel B. | 9.81 | 30.89 | C |
| 2 | 11 | 4 Lane Ends | 0.0 | - | E |
| | 11A | Park Wood | 0.74 | 118.58 | D |
| | 12 | Lincoln Inn | 1.59 | 117.49 | D |
| | 13 | Thwaites | 2.36 | 90.98 | D |
| | 14 | Fleetholme | 0.05 | 173.21 | D |
| | 15 | Fairmile | 0.31 | 181.11 | D |
| | 16 | Yorkshire Br. | 2.26 | 88.61 | D |
| 3 | 6 | Kirkby Lonsdale | 0.07 | 134.77 | D |
| | 7 | Linderlay | 0.0 | - | E |
| | 8 | Rigmaden | 0.0 | - | E |
| | 9 | Middleton | 0.03 | 152.75 | D |
| | 10 | HallBeck | 0.04 | 238.48 | D |
| 4 | 1 | Caton | 0.05 | 173.21 | D |
| | 2 | Snab | 0.0 | - | E |
| | 3 | Gressingham | 0.0 | - | E |
| | 4 | Newton | 0.08 | 125.00 | D |
| | 5 | Whittington | 0.02 | 223.61 | D |
| 5 | 109 | Birk B. | 1.00 | 472.14 | D |
| | 110 | Birk B. | 1.91 | 66.64 | D |
| | 111 | Birk B. | 5.05 | 81.77 | C |
| | 112 | Bretherdale B. | 4.58 | 98.88 | D |
| | 113 | Borrowdale B. | 4.42 | 118.36 | D |
| | 114 | Borrowdale B. | 6.31 | 32.56 | C |
| 6 | 115 | Chapel B. | 17.01 | 58.80 | B |
| | 116 | Croasdale B. | 31.37 | 60.11 | A |
| 7 | 117 | Ingmire | 0.03 | 333.33 | D |
| | 118 | Sedbergh | 3.23 | 62.23 | D |
| | 119 | Burnt Mill | 6.29 | 41.27 | C |
| | 119A | Cautley | 2.63 | 121.26 | D |
| | 120 | Rawthey | 3.34 | 48.55 | D |
| 8 | 121 | Clough | 2.62 | 77.57 | D |
| | 122 | Clough | 13.23 | 132.11 | B |
| | 123 | Clough | 22.72 | 111.80 | A |

Table 5. (Cont.)

| Subcatchment | Site | Site Name | Mean Value (N/100m2) | CV | Class |
|---|---|---|---|---|---|
| 9 | 124 | Dee | 0.19 | 411.07 | D |
| | 125 | Dee | 0.78 | 256.41 | D |
| | 126 | Dee | 3.64 | 78.86 | D |
| | 127 | Dee | 13.23 | 75.71 | B |
| 10 | 128 | Barbon B. | 0.16 | 279.51 | D |
| | 129 | Barbon B. | 0.78 | 119.58 | D |
| | 130 | Barbon B. | 7.88 | 173.77 | C |
| | 131 | Leck B. | 2.56 | 257.25 | D |
| | 132 | Leck B. | 9.44 | 76.93 | C |
| 11 | 133 | Greta | 1.22 | 159.15 | D |
| | 134 | Greta | 0.15 | 163.30 | D |
| | 135 | Greta | 0.33 | 309.03 | D |
| | 136 | Greta | 9.45 | 68.43 | C |
| | 137 | Doe | 0.82 | 102.76 | D |
| | 137A | Doe | 1.17 | - | D |
| | 138 | Greta | 10.25 | 49.24 | B |
| 12 | 139 | Wenning | 0.87 | 123.80 | D |
| | 140 | Wenning | 0.54 | 114.16 | D |
| | 141 | Wenning | 0.0 | - | E |
| | 142 | Wenning | 1.67 | 61.36 | D |
| | 143 | Wenning | 4.62 | 99.54 | D |
| | 144 | Wenning | 10.73 | 71.92 | B |
| | 145 | Wenning | 4.20 | 87.45 | D |
| | 146 | Wenning | 1.07 | 94.85 | D |
| | 147 | Wenning | 0.0 | - | E |
| | 148 | Clapham B. | 9.66 | 21.74 | C |
| | 149 | Austwick B. | 0.0 | - | E |
| | 150 | Austwick B. | 1.99 | 51.98 | D |
| | 151 | Austwick B. | 5.32 | 65.36 | C |
| | 151B | Austwick B. | 5.39 | - | C |
| | 152 | Fen B. | 4.32 | 91.57 | D |
| | 153 | Keasden B. | 6.73 | 76.99 | C |
| 13 | 154 | Hindburn | 4.18 | 79.70 | D |
| | 155 | Hindburn | 12.23 | 43.49 | B |
| | 156 | Hindburn | 19.23 | 38.68 | B |
| | 157 | Roeburn | 5.99 | 61.29 | C |
| | 158 | Roeburn | 12.96 | 86.41 | B |

On the basis of mean site densities (Table 5) the most productive sites for trout parr were site 114 on Borrowdale Beck and site 111 on Birk Beck (both class C). The former site showed the least variation about the mean (32.6% compared to 81.8%).

### 4.4.6 Subcatchment 6: The Chapel Beck/Croasdale Beck System

Site 116 on Croasdale Beck was the most productive site for 0+ trout in the River Lune catchment. The density of fry in 1982 was found to be 502.1+/-93.4/100m$^2$. Very high densities of this order of magnitude were also recorded in 1984 and 1985. A mean site density of 426+/-167.3/100m$^2$ (class A) was recorded with a CV of 17.9% indicating a small degree of variation about the mean. By comparison site 115 (Chapel Beck) was less productive but nevertheless strong year classes were produced in 1984 (113.1+/-40.8/100m$^2$, class A) and 1985 (89.4+/-6.9/100m$^2$, class B). The site mean was 53.3+/-3.4/100m$^2$ (class B) with a CV of 76.8%.

1+ densities were high at both sites with a maximum of 53.3+/-3.4/100m$^2$ being recorded at site 116 in 1985. On the basis of mean densities site 116 (Croasdale Beck) was categorised as class A (CV of 60.1%) and site 115 (Chapel Beck) class B (CV of 58.8%).

### 4.4.7 Subcatchment 7: The Rawthey System

0+ trout densities in this subcatchment were low (class D) as indicated by the mean site densities (Table 4). The most productive area was site 120 with a mean density of 23.9+/-97.4/100m$^2$ (class D) and a CV of 28.3%.

Site 119 (Burnt Mill) was the most productive for 1+ trout having a mean site density of 6.3+/-29.8/100m$^2$ (class C) with a low CV (41.3%).

### 4.4.8 Subcatchment 8: The Clough System

Mean site densities of trout fry at the three sites in this subcatchment ranged from class C to D and there was a high degree of variation about the mean (CV of 166% to 221%).

1+ trout production was high at sites 122 and 123 where the mean site densities registered as class B and A respectively with an associated CV of 132.1% and 111.8%. This subcatchment was one of the most productive for trout parr.

### 4.4.9 Subcatchment 9: The Dee System

As a whole this subcatchment produced low densities of trout fry and parr (class D) as indicated by the mean site densities (Tables 4 and 5). The exception to this was site 127 which yielded a mean density for 0+ trout of 47.1+/-104.9/100m$^2$ (class C) and a CV of 88.6%. Mean 1+ densities were good at this site (class B).

### 4.4.10 Subcatchment 10: The Barbon Beck/Leck Beck System

On the basis of mean site densities most of the sites in this subcatchment registered as class D for 0+ trout (Table 4). The exception to this was site 132 (Leck Beck) where a mean of 33.2+/-56.9/100m$^2$ (class C) was recorded with a CV of 81.4%.

The most productive sites for 1+ trout were found to be site 132 (Leck Beck) and 130 (Barbon Beck), both class C. Productivity at the latter site was more consistent as indicated by the lower CV (76.9% compared to 173.8%).

### 4.4.11 Subcatchment 11: The Greta System

Mean site densities in this subcatchment were low with most of the sites registering as class D (Table 4). Site 136 was more productive having a mean of 29.3+/-113.9/100m$^2$ (class C), but there was a relatively high variation about the mean (139%).

The 1+ mean site density characteristic for 5 of the 7 sites in the subcatchment were class D. By comparison sites 136 and 138 were quite productive with mean densities registering as class C and B respectively and having low CV (68.4% and 49.2% respectively).

### 4.4.12 Subcatchment 12: The Wenning System

With mean site densities less than 25/100m$^2$ the majority of sites were categorised as class D for 0+ trout (Table 4). The most productive areas were sites 150 and 151 on Austwick Beck which had mean densities of 50+/-124/100m$^2$ (class B) and 138.7+/-157.9/100m$^2$ (class A) respectively. The high mean density and low CV (48.3%) of site 151 ranks it as one of the most productive sites for trout fry in the Lune catchment.

The catchment as a whole was of low productivity for 1+ trout, 63% of the sites had mean densities registering as class D/E (n=16). Site 144 on the Wenning was the most productive site of the subcatchment having a mean of 10.7+/-22.9/100m$^2$ (class B) and a CV of 71.9%. With the exception of this site most 1+ production was confined to the tributaries where mean densities were categorised as class C. These were sites 148 (Clapham Beck), 151 and 151b (Austwick Beck) and 153 (Keasden Beck) (Table 5).

### 4.4.13 Subcatchment 13: The Hindburn/Roeburn System

Mean 0+ densities were low in all but one of the 5 sites sampled (class D). Site 158 (Roeburn) was the most productive site of the subcatchment (class C) with a CV of 96.5% (Table 4).

Parr production at 3 of the 5 sites in this subcatchment were high (class B) and these were sites 155, 156 (Hindburn) and 158 (Roeburn). Site 156 (Hindburn) was the most productive site of the subcatchment with a mean density of 19.2+/- 14.6/100$m^2$ (class B) and a low CV (38.7%).

## 4.5 Site Mean Density and Coefficient of Variation

There was considerable variation in densities between years and this is expressed by large 95% confidence limits associated with the means (Appendices 2 to 5) and by high values of the coefficient of variation (Tables 2 to 5). The mean site density over the 1981 to 1985 period was plotted against coefficient of variation (Fig. 23). The results for fry and parr of both salmon and trout show the same trend i.e. as the mean density increases CV decreases. Thus sites with a low temporal CV are most likely to be those with high densities of juvenile salmonids.

## 4.6 Analysis of Year Class Strength

The relationship between the abundance of a year class in a particular year and its abundance in the subsequent year was examined by regression analysis. The results for both salmon and trout data showed that parr density at a given site in a given year was significantly correlated with fry density from the previous year. 0+ data from 1981 was omitted from the analysis because fishing effort was not comparable with the other surveys. In the case of salmon 20% to 47% of the variation in 1+ density could be explained by the density of fry which was present at that site in the year before:

<u>1+ Salmon 1983</u>

Log (1+ Salmon 1983) = 0.487 + 0.359 Log (0+ Salmon 1982)

$R^2$ = 26% $p < 0.0001$ (Significant)

<u>1+ Salmon 1984</u>

Log (1+ Salmon 1984) = 0.683 + 0.478 Log (0+ Salmon 1983)

$R^2$ = 47% $P < 0.0001$ (Significant)

<u>1+ Salmon 1985</u>

Log (1+ Salmon 1985) = 0.487 + 0.284 Log (0+ Salmon 1984)

$R^2$ = 20% $p < 0.0001$ (Significant)

FIG. 23 RELATIONSHIP BETWEEN CV AND MEAN
1981-1985
0+ SALMON

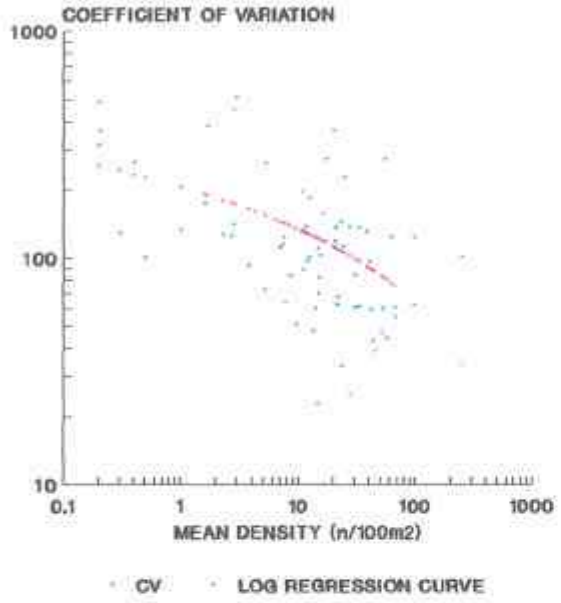



FIG. 23 RELATIONSHIP BETWEEN CV AND MEAN
1981-1985
1+ SALMON

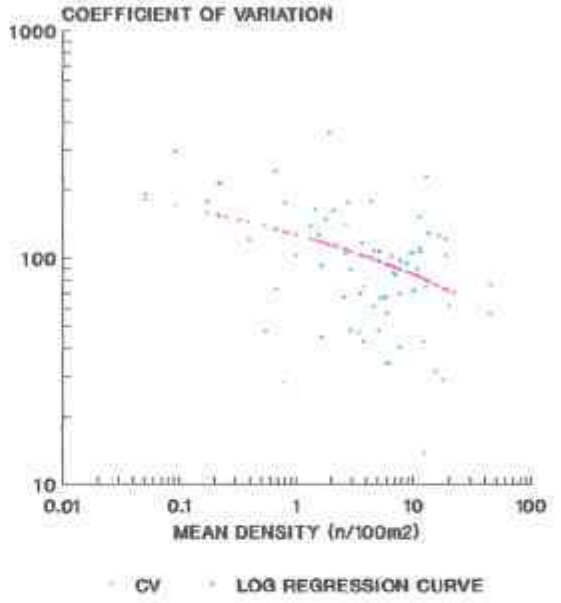



FIG. 23 RELATIONSHIP BETWEEN CV AND MEAN
1981-1985
0+ TROUT

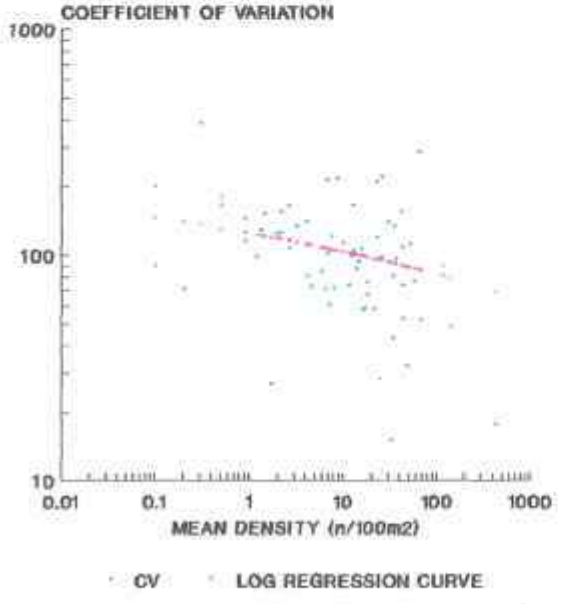
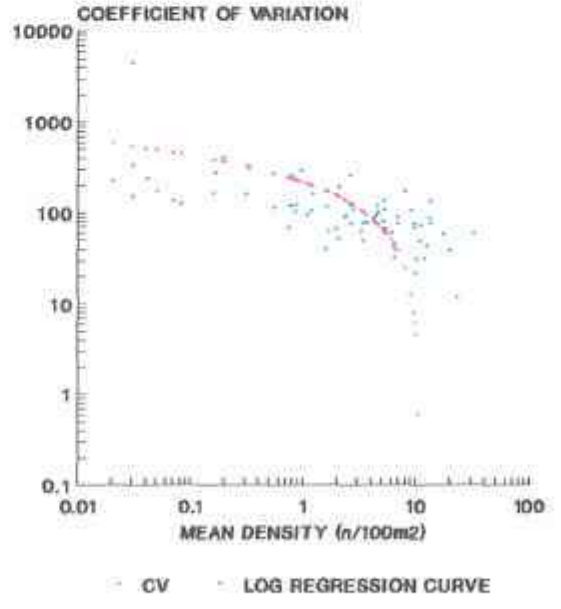



FIG. 23 RELATIONSHIP BETWEEN CV AND MEAN
1981-1985
1+ TROUT



The relationship was also found to be significant between 0+ trout and 1+ trout where 13% to 52% of the variation in 1+ density was accounted for by fry density of the previous year.

1+ Trout 1983

Log (1+ Trout 1983) = 0.293 + 0.473 Log (0+ Trout 1982)

$R^2$ = 52% $p < 0.0001$ (Significant)

1+ Trout 1984

Log (1+ Trout 1984) = 0.287 + 0.534 Log (0+ Trout 1983)

$R^2$ = 40% $p < 0.0001$ (Significant)

1+ Trout 1985

Log (1+ Trout 1985) = 0.638 + 0.206 Log (0+ Trout 1984)

$R^2$ = 13% $p < 0.004$ (Significant)

### 4.7 Cluster Analysis

After running the program several times it was found that the value of K (number of divisions of the data set) which gave rise to the most meaningful clusters was 7.

#### 4.7.1 0+ Salmon 1981-1985

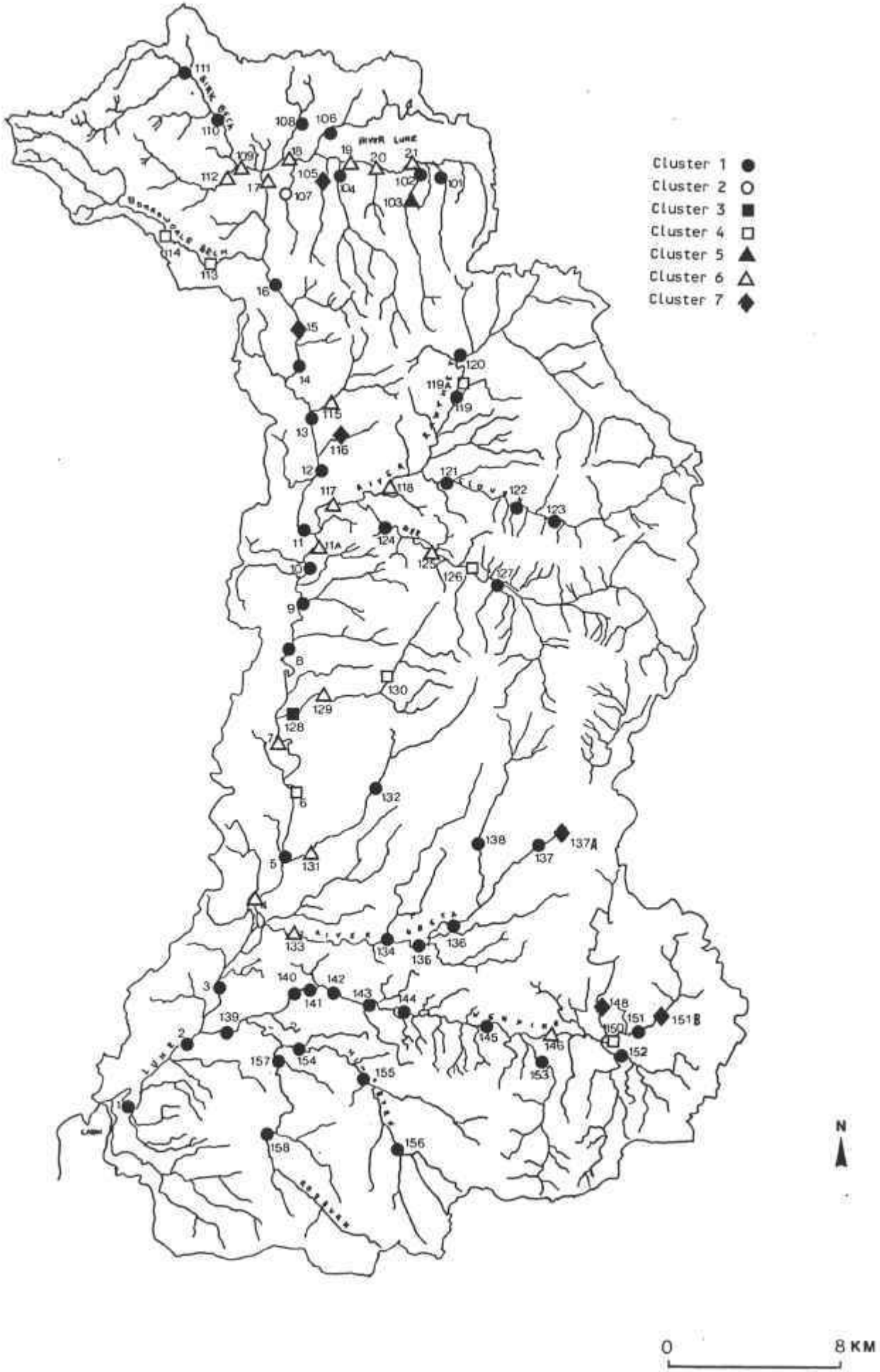
The summary F ratios at the beginning of Appendix 6 indicate that the variables 1983 and 1982 are better discriminators between records than other years. These were the most productive years for 0+ salmon as indicated by the abundance categories in Fig. 3. 19.5% of sites in 1983 were class A/B and 16.5% of sites in 1982 were class A/B.

The majority of sites were incorporated into cluster 1 and most of these were categorised as class D based on mean site densities of 0+ salmon. This cluster included the Clough and Hindburn/Roeburn subcatchments; most of the sites of the Wenning, upper middle Lune, lower middle Lune, lower Lune, and Greta; half of the Dee subcatchment and 5 tributaries of the upper Lune (Fig. 24).

Cluster 4 isolated sites with mean densities of class C and D. Of the 7 sites in this group 5 produced maximum densities which registered as class A/B at some stage during the 1981 to 1985 period.

Clusters 2 (class A), 3 (class B) and 5 (class B) appeared as single site groups of high densities. Cluster 2 singled out Tebay Gill (site 107) because of the extremely high density recorded there in 1983 ($505.6+/-60.3/100m^2$). High densities with a maximum of $279.9+/-32.4/100m^2$ in 1984 singled out Barbon Beck (site 128) in cluster 3. Cluster 5 consisted of

Fig. 24 Cluster Analysis On 0+ Salmon Data, 1981-1985



Bowderdale Beck (site 103) where densities ranged from class A to E with a maximum of 152.6+/-61.5/100m$^2$.

Cluster 6 formed the second largest group with mean densities ranging from class B to D and consisting of 18 sites, five of which were main river sites of the upper Lune subcatchment.

Cluster 7 selected for sites which tended to have very low densities (class D/E). Although the mean density at site 116 (Croasdale Beck) was categorised as class B, as a result of a particularly good year class in 1982, densities of class D and E were recorded on subsequent surveys hence the inclusion of this site in cluster 7.

### 4.7.2 1+ Salmon 1981-1985

In this instance 1983 and 1984 were the better discriminators between sites (Appendix 7).

The majority of sites were placed in cluster 1 and this group tended to have low densities, most sites having a mean density of class D. This included the Clough, Hindburn/Roeburn subcatchments, all but one site of the Dee, most of the Wenning, upper middle Lune, lower middle Lune, lower Lune, Rawthey; half of the Greta sites and 5 sites from the upper Lune subcatchment (Fig. 25).

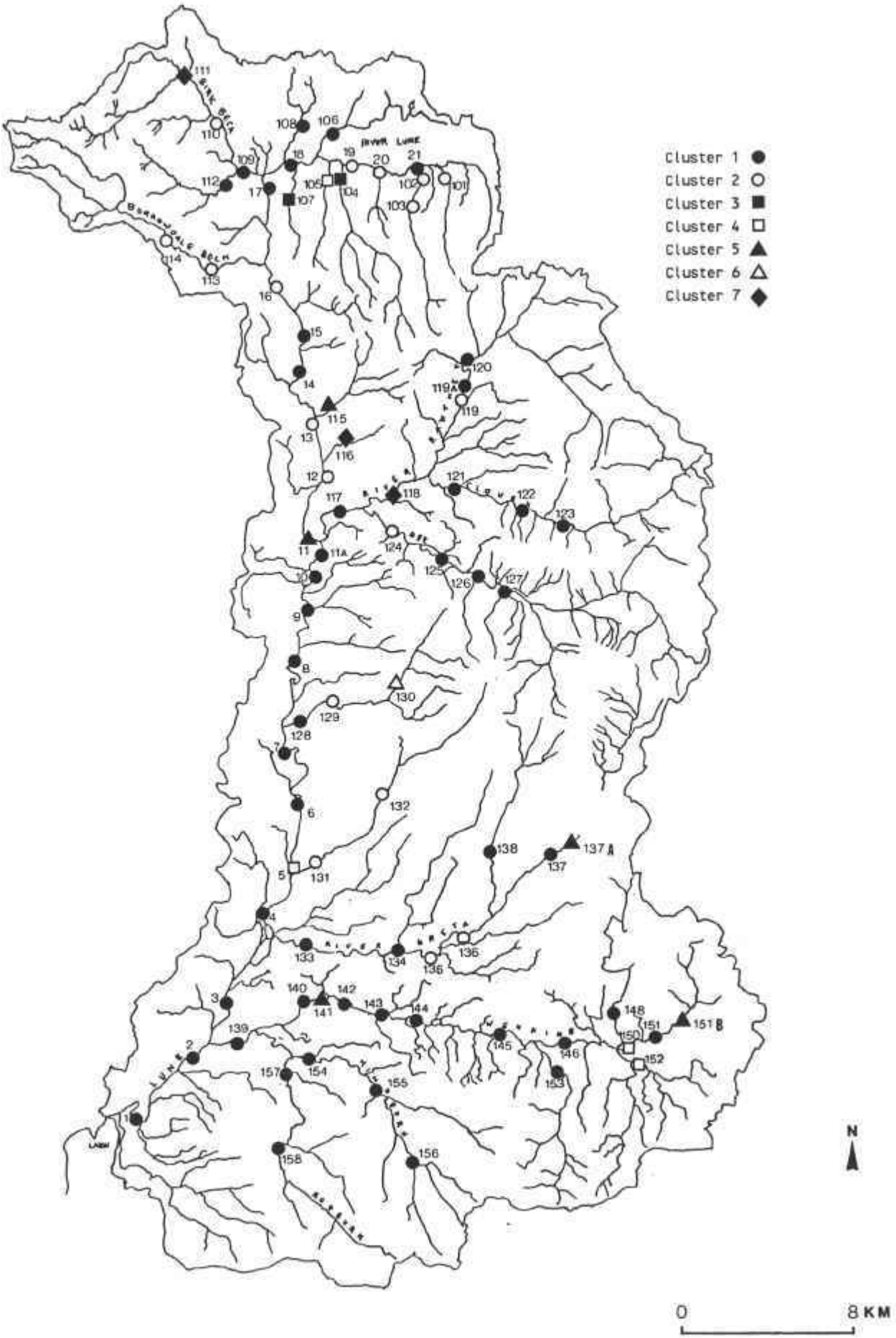
The next largest group was cluster 2 which consisted of sites having moderate to good densities (class C and B); 5 of these were from the upper Lune subcatchment, half of the upper middle Lune sites, Birk Beck/Borrowdale Beck, and Barbon Beck/Leck Beck subcatchment.

Sites in clusters 4 and 5 were in general characteristic of low densities (the majority of site means being classified as D/E), although strong year classes were observed on occasion at sites 105 (Ellergill beck) and 115 (Chapel Beck).

Tebay Gill (107) and Longdale Beck (104) were isolated in cluster 3 because of the very high densities being recorded in 1983 and 1984 (class A and B respectively). These were the best results for any site in the catchment.

Cluster 6 (Barbon Beck, 130) and 7 (Birk Beck, 111; Croasdale Beck, 116; Sedbergh, 118) also produced good to excellent densities (class A/B) but not as high as the maximum values recorded in cluster 3.

Fig. 25 Cluster Analysis On 1+ Salmon Data, 1981-1985



### 4.7.3 0+ Trout 1981-1985

1982 and 1985 were better discriminators between sites than other years due to the very high densities recorded at a few sites (Appendix 8).

Cluster 1 contained sites of low densities (the majority of which had mean densities registering as class D) incorporating Barbon Beck/Leck Beck, lower middle Lune and lower Lune subcatchments; all but one site in the subcatchments Birk Beck/Borrowdale Beck, Rawthey, Greta, Wenning, Hindburn/Roeburn, 4 sites from the upper Lune, most of the upper middle Lune, and half of the Dee subcatchment (Fig. 26).

Cluster 3 identified areas of very low densities (mean densities of class D and E), all but one site with densities less than 10.3/100m$^2$ over the 5 year period. Four of these sites were from the upper middle Lune subcatchment. Site 107 (Tebay Gill) was included in this group because of the low densities recorded in 1982, 1983 and 1984 (class E, E and D respectively), however a strong year class was produced in 1985 (class A).

Cluster 2 separated out Croasdale Beck (116) as a site of very high densities of 0+ trout (mean site density of class A), but the inclusion of Austwick Beck (151b) in this group appears to be an anomaly. This site was only sampled once having a density of 12.8+/-3.9/100m$^2$ compared to densities of 349.8+/-173.9 to 502.1+/-93.4/100m$^2$ recorded at Croasdale Beck.

Clusters 5 and 6 were also high density groups containing one site each. Austwick Beck (151) being in cluster 5 and Weasdale Beck (101) in cluster 6 (both class A). The reason for the partitioning between these groups may be the greater variability at Weasdale Beck (CV of 90.5% compared to 48.3% at site 151).

Clusters 7 consisted of sites with mean densities of class C/D. Cluster 4 contained higher density sites which were primarily class C but often producing a strong year class. Six of the sites in cluster 4 are tributaries of the upper Lune subcatchment.

### 4.7.4 1+ Trout 1981-1985

1984 was found to be the most important discriminator between sites and was also the most productive year for 1+ trout in terms of the percentage of sites in class A and B density categories (Appendix 9, Fig. 3).

Cluster 1 identified sites with very low densities (the majority of which had a mean density of class D) including 8 sites from the upper Lune subcatchment, all sites from the upper middle Lune, lower middle Lune, lower Lune; nearly all the sites of the Rawthey and the Dee; most of the Greta; and half of the Wenning (Fig. 27).

Fig. 26 Cluster Analysis On 0+ Trout Data, 1981-1985

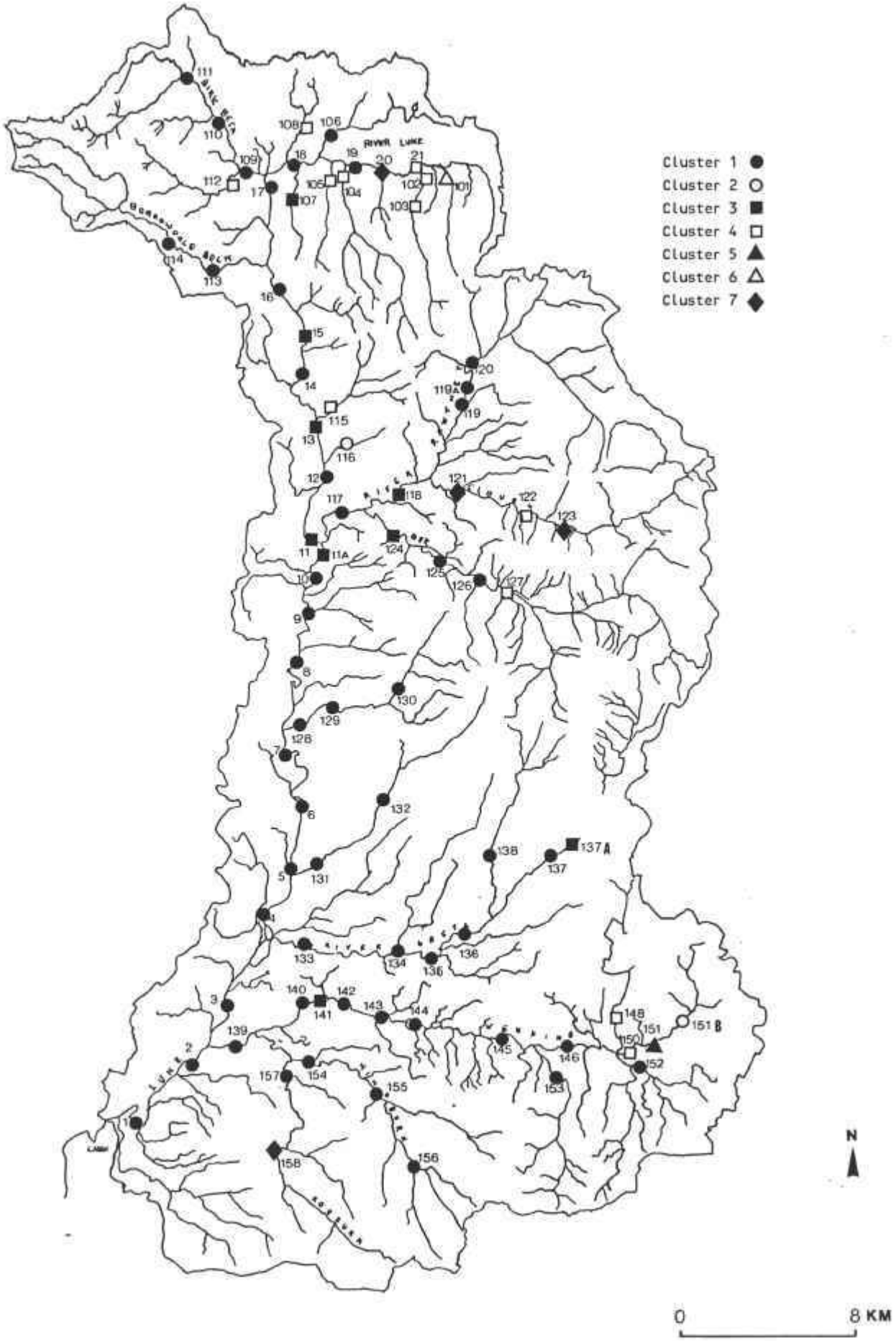
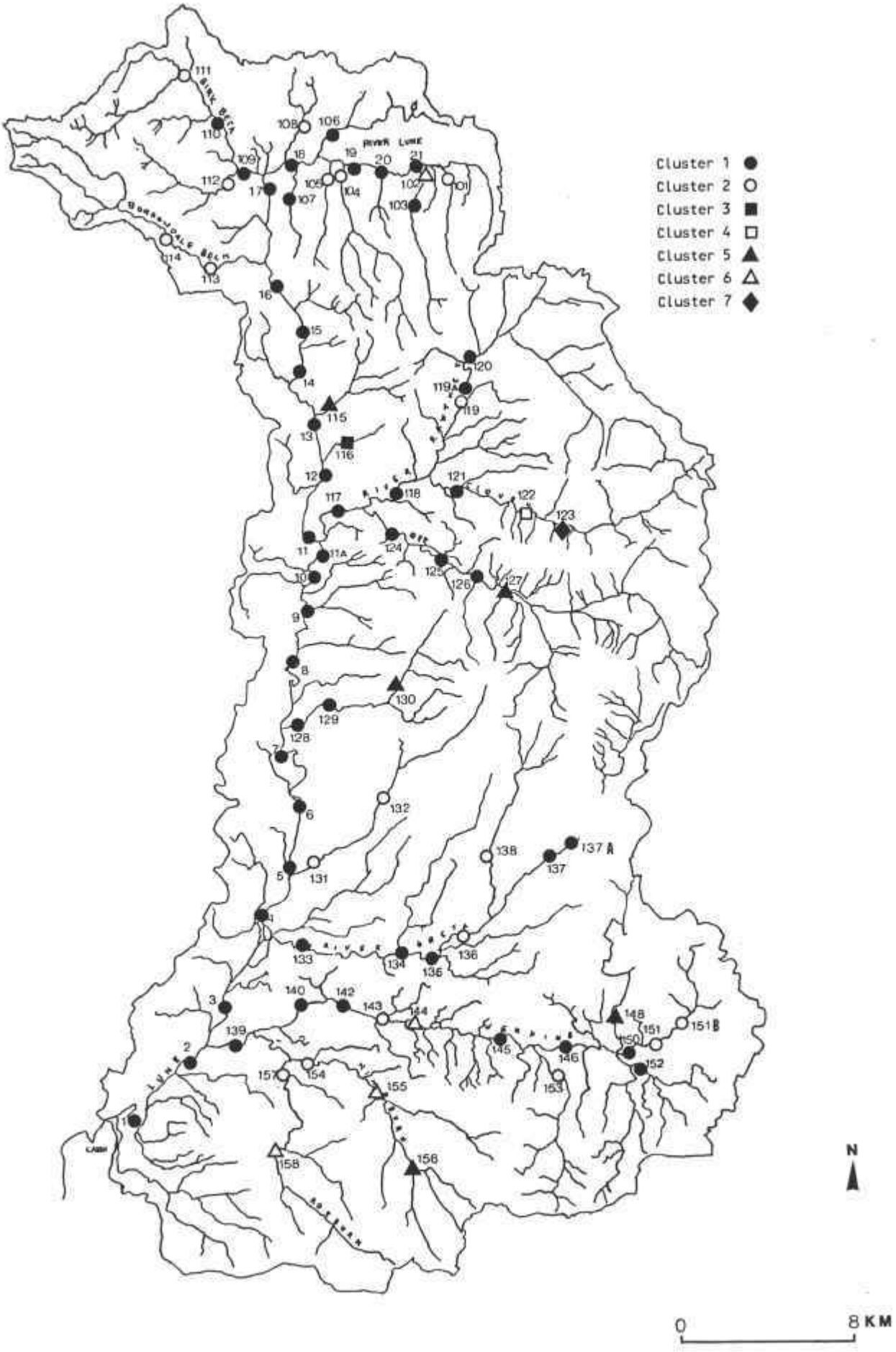


Fig. 27 Cluster Analysis On 1+ Trout Data, 1981-1985



Cluster 2 incorporated sites with moderate densities (predominantly class C with a range of class D to B). Most of the Birk Beck/Borrowdale Beck sites were present and 4 becks from the upper Lune subcatchment.

Clusters 3 and 7 identified the high density sites (class A), namely Croasdale Beck (116) and Clough (123). The mean density at the latter site had a greater degree of variation associated with it over the 1981 to 1985 period, hence the separate grouping.

Clusters 4, 5, and 6 contained sites having mean densities registering as class B, incorporating Clough (122) in cluster 4 and some of the Wenning, Hindburn/Roeburn sites in clusters 5 and 6. The sites in these clusters had similar abundance characteristics however those in cluster 6 had lower CV than sites in cluster 4, and cluster 5 sites tended to have higher mean densities and lower CV than cluster 6 sites.

### 4.7.5 0+ and 1+ Salmon 1981-1985

1983 was the best discriminator between sites, this being selected by the high densities of 0+ fish relative to 1+ fish. (Appendix 10).

Cluster 1 identified sites of low productivity with 0+ mean densities registering predominantly as class D and 1+ production also being dominated by class D sites, but with a range of class E to B. This cluster included all sites from the Clough and Hindburn/Roeburn subcatchments, all but one of the Greta and Wenning sites, half of Dee sites, 6 tributary sites from the upper Lune subcatchment, most of the upper middle Lune, lower middle Lune and lower Lune (Fig. 28).

Cluster 2 isolated Tebay Gill (site 107) because of the very high densities of 0+ and 1+ salmon recorded in 1983 and 1984 (class A).

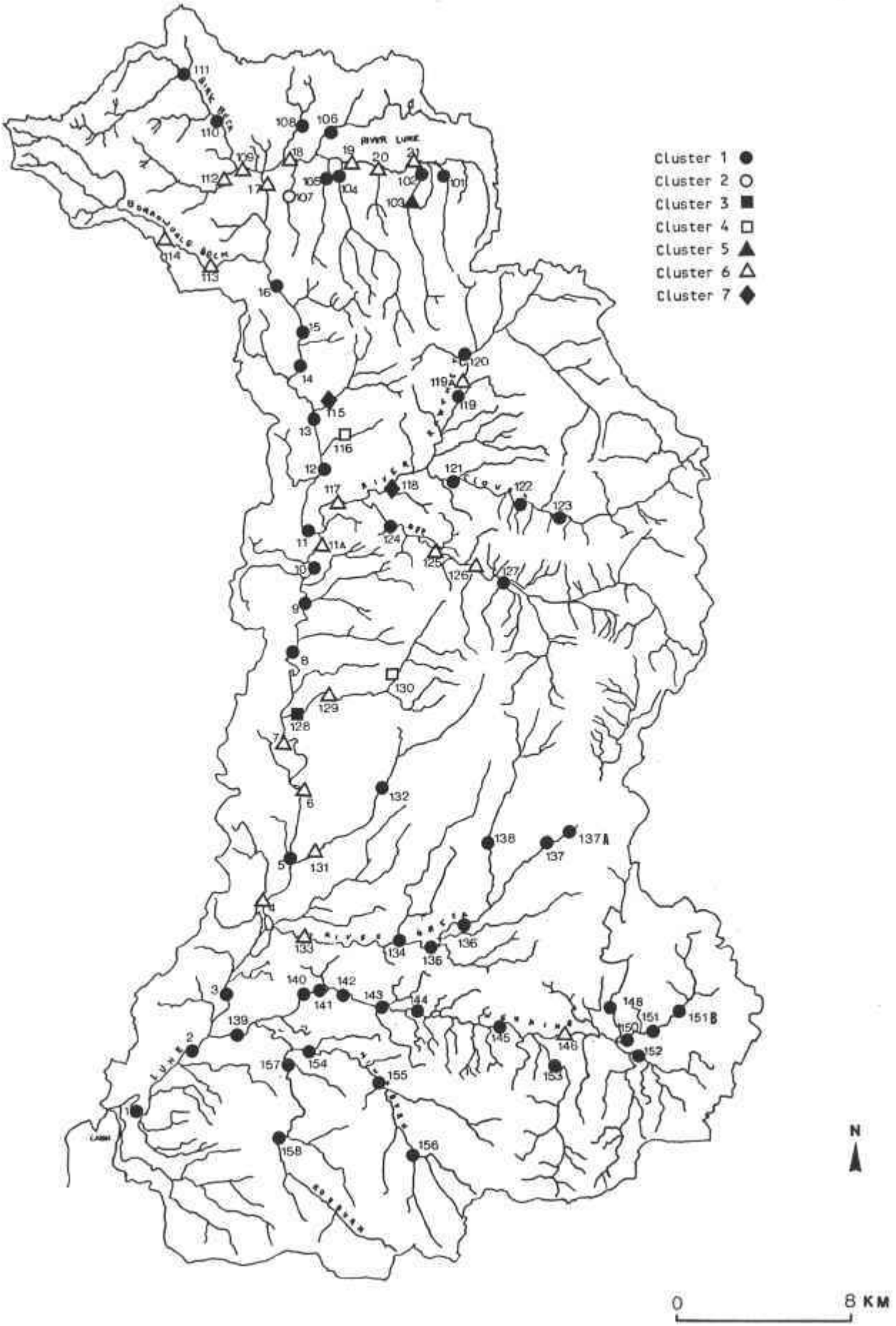
Cluster 3 consisted of site 128 (Barbon Beck) which was characterised by high 0+ densities (class B) and moderate 1+ densities (class C).

Cluster 4 consisted of site 116 (Croasdale Beck) and site 130 (Barbon Beck). These sites were relatively productive for parr with densities of class B. 0+ mean densities of class B/D were recorded.

Cluster 5 isolated Bowderdale Beck (site 103) as another productive site for 0+ salmon (mean density of class B) with moderate densities of parr (class C). In this respect cluster 5 had similar characteristics to cluster 3 but was separated on the basis of having lower 0+ mean densities.

Cluster 6 identified sites which in general were characteristic of low to moderate densities of juvenile salmon (class D/C). This included 5 sites from the upper Lune

Fig. 28 Cluster Analysis On 0+ And 1+ Salmon Data, 1981-1985



subcatchment (which were main river sites) and the majority of the Birk Beck/Borrowdale Beck subcatchment.

Chapel Beck (site 115) and Sedbergh (site 118) of cluster 7 were quite productive sites with mean 0+ densities ranging from class C to B and 1+ densities from B to A. Site mean densities in this cluster were similar to that recorded in cluster 4, however cluster 7 sites had less variation about the mean for 0+ salmon.

### 4.7.6 0+ and 1+ Trout 1981-1985

1982 and 1985 were the best discriminators between the years as indicated by the F ratios which were strongly influenced by 0+ densities (Appendix 11).

Cluster 1 contained most of the sites and was representative of low densities, the majority of the sites having a mean density of class D for 0+ and 1+ trout. All except one site in each of the following subcatchments was present: Birk Beck/Borrowdale Beck, Rawthey, Barbon/Leck Beck, Greta, and Hindburn/Roeburn. Also present were the majority of the Wenning sites, half of the upper middle Lune, lower middle Lune, lower Lune, Dee, and 4 sites from the upper Lune subcatchment (Fig. 29).

Cluster 3 identified sites tending to have very low mean densities of juvenile trout (class D). Maximum densities at these sites were relatively low and were presumably the basis for the differentiation between the sites in this cluster and cluster 1. About half of the upper middle Lune sites were incorporated into this group.

Cluster 2 isolated Croasdale Beck (site 116) as a prolific 0+ trout site with high densities of parr (class A).

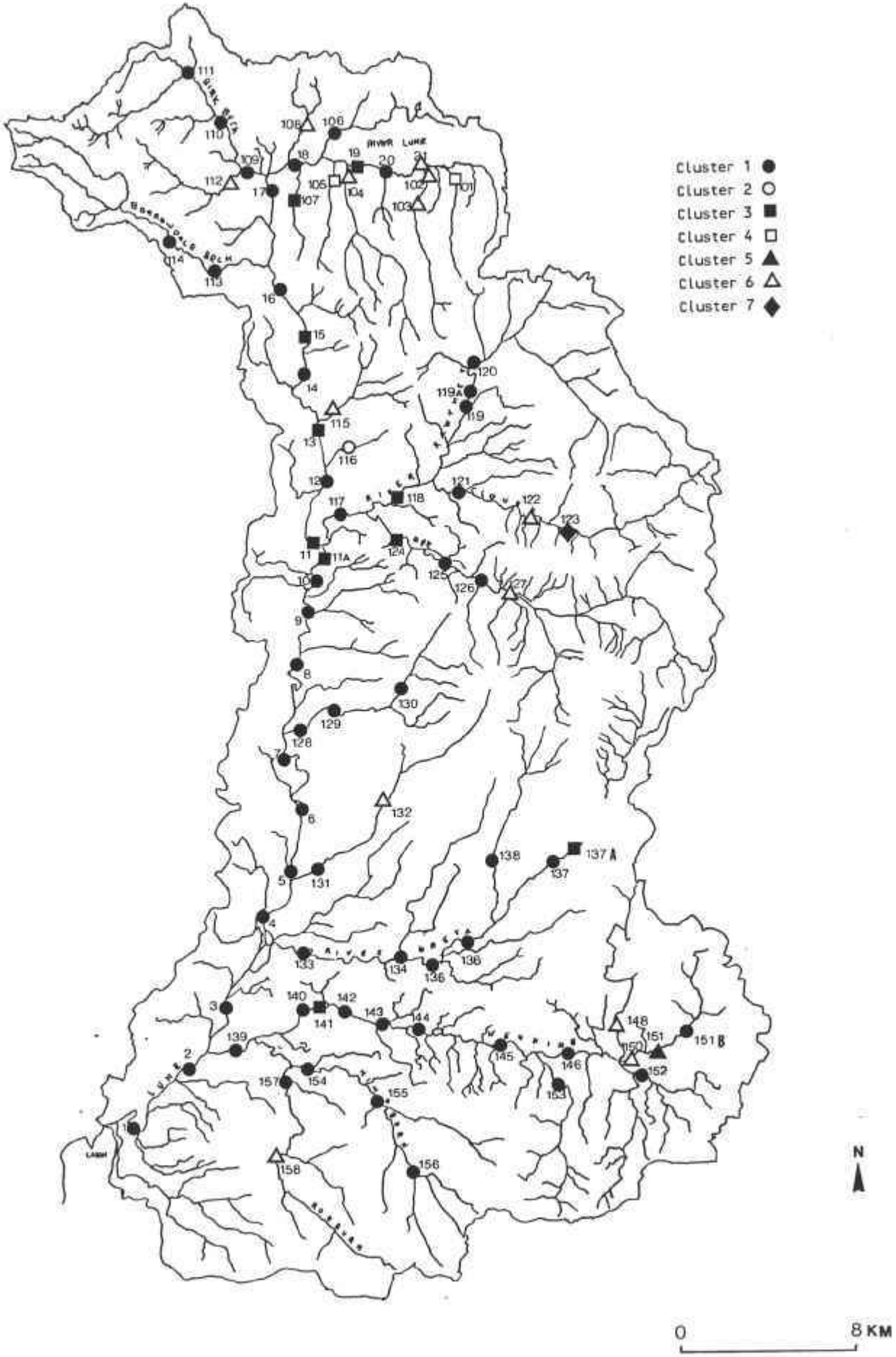
Cluster 4 included Weasdale Beck (site 101) and Ellergill Beck (site 105). These sites produced class A/B 0+ densities and class B/C 1+ densities.

Cluster 5 separated Austwick Beck (site 151) which also had high 0+ (class A) and moderate 1+ densities (class C), but was partitioned from cluster 4 because of the higher mean density and lower CV of 0+ trout.

Cluster 6 was characterised by sites with mean densities registering as class C. This cluster included 5 sites from the upper Lune subcatchment.

Cluster 7 contained site 123 on the Clough where although mean 0+ densities were found to be low (class D), 1+ densities were high (class A).

Fig. 29 Cluster Analysis On 0+ And 1+ Trout Data, 1981-1985



### 4.7.7 0+ Salmon and 0+ Trout 1981-1985

1982 and 1985 densities for 0+ trout were the better discriminators among the variables followed by 1983 densities for 0+ salmon (Appendix 12). The highest densities of the 5 year period were recorded during these years.

All but 10 sites were present in cluster 1 which was in general characterised by low densities of 0+ trout and salmon (mean site density of class D) (Fig. 30).

Cluster 2 isolated Croasdale Beck (site 116) because very high densities of 0+ trout were recorded there over the 5 year period (class A). 0+ salmon production was more variable ranging from class A to E and had a very high CV associated with the mean which could explain why this site was included with Greta/Doe (site 137a) and Wenning/Austwick Beck (site 151b).

Cluster 3 separated out Tebay Gill (site 107) which produced quite variable results for both salmon and trout occasionally yielding exceptionally high densities. The mean site density for salmon was found to be class A and class B for trout.

Cluster 4 isolated Barbon Beck (site 128) on the basis of high 0+ salmon densities (mean of class B) and low 0+ trout densities (mean of class D). Conversely, Weasdale Beck (site 101) and Ellergill Beck (site 105) were placed in cluster 5 by virtue of low 0+ salmon densities (mean of class D) and high 0+ trout densities (mean of class A and B respectively). Austwick Beck (site 151) in cluster 6 showed the same trend, but was less variable about the mean.

Cluster 7 contained Bowderdale Beck (site 103) and Longdale Beck (site 104). Mean densities of 0+ salmon at these sites registered as class B and D respectively and for trout class C at both sites. There was less variation associated with the mean values for trout compared to salmon.

### 4.7.8 1+ Salmon and 1+ Trout 1981-1985

Trout 1985 and salmon 1983 were the better discriminators of the variable list (Appendix 13).

Cluster 1 contained the majority of sites including 6 of the upper Lune sites, most of the Dee, Greta, Wenning, upper middle, lower middle and lower Lune, half of the Birk Beck/Borrowdale Beck subcatchment and all but one of the Rawthey sites. Most of the sites in this cluster had mean densities of class D for both 1+ salmon and trout (Fig. 31).

Cluster 5 identified Croasdale Beck (site 116) as a site with high densities of both salmon (mean density of class B) and trout parr (mean density of class A).

Cluster 4 recognised two sites, Longdale Beck (site 104) and Tebay Gill (site 107). These sites probably formed a separate

ig. 30 Cluster Analysis On 0+ Salmon And 0+ Trout Data, 1981-1985

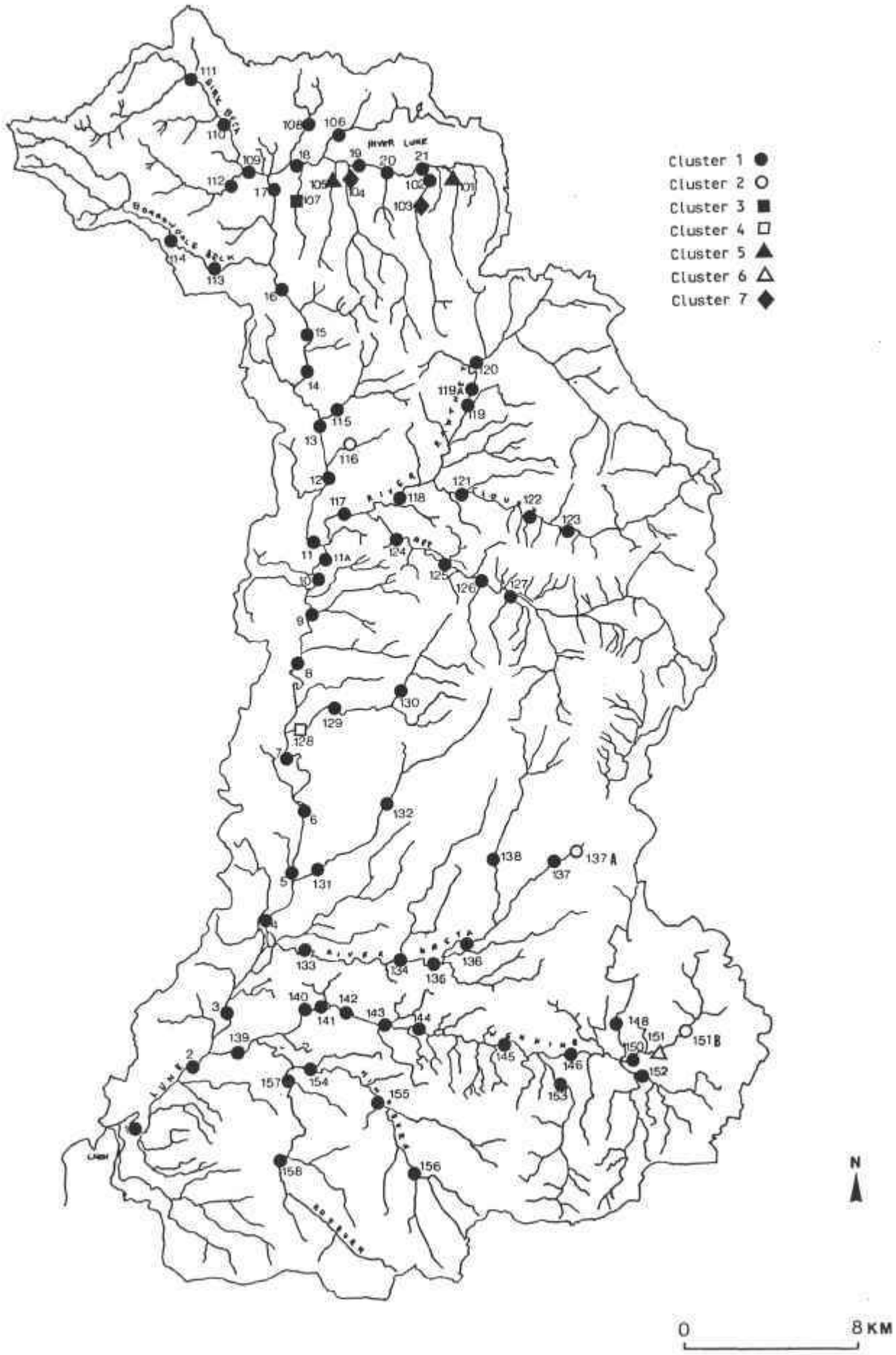
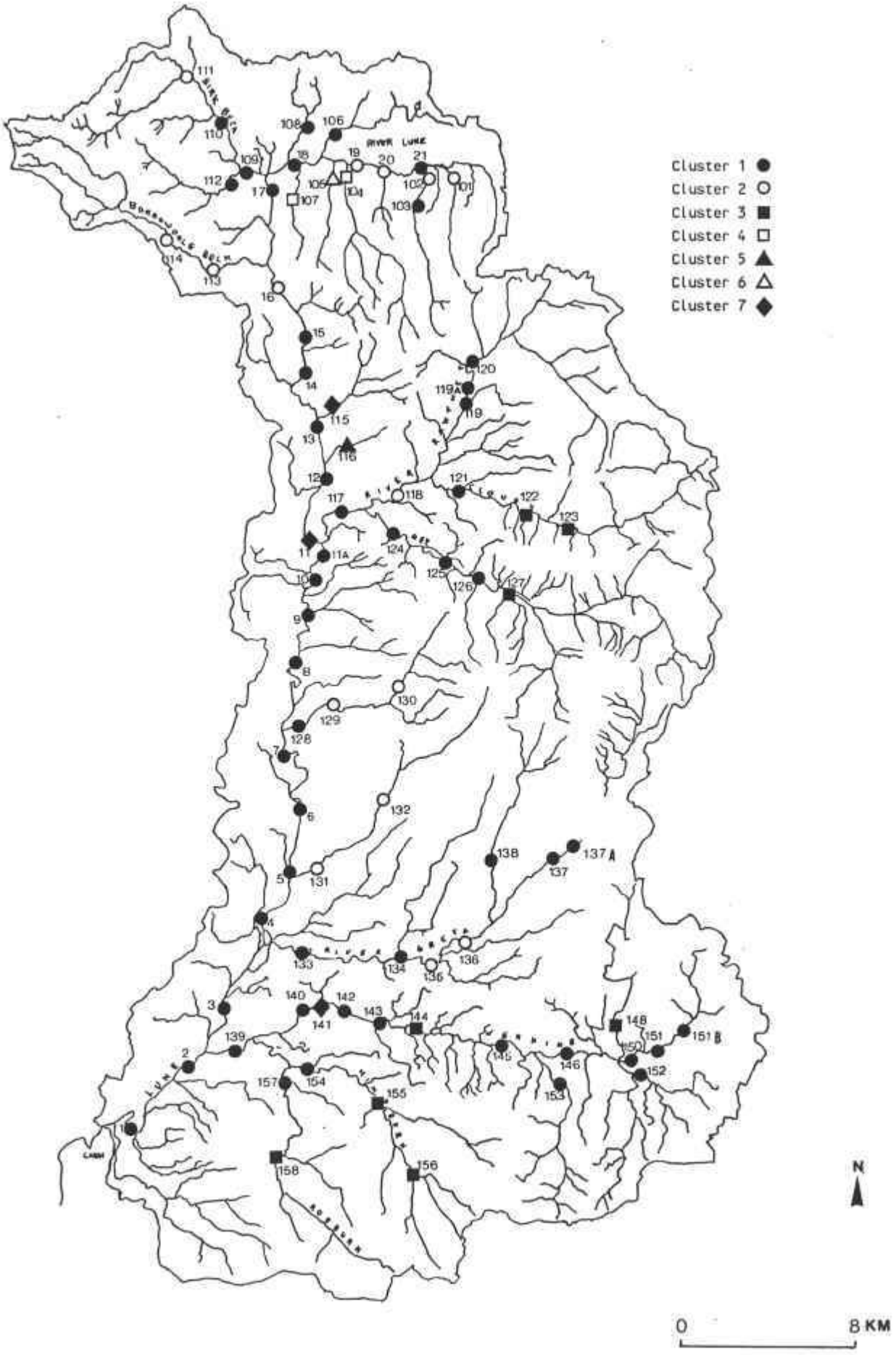


Fig. 31 Cluster Analysis On 1+ Salmon And 1+ Trout Data, 1981-1985



cluster because of the very high maximum densities of salmon parr recorded in 1983 and 1984, class B in the former case and class A in the latter. 1+ trout densities were not as high, site 104 (Longdale Beck) having a mean density of class C and site 107 (Tebay Gill) having a mean density of class D.

Cluster 3 isolated eight sites including two of the three Clough sites and almost half of the Hindburn/Roeburn sites as having low salmon parr densities (mean densities of class C to E) and moderate to good trout parr densities (mean densities of class A to C).

Ellergill Beck (site 105) was isolated in cluster 6. Salmon and trout parr densities registered as class B based on mean densities. The mean density of salmon parr was elevated by the very high density of parr recorded in 1983 and hence the degree of variation about the mean was high (CV = 120.5%). Trout parr production was less variable (CV = 31.3%).

Cluster 7 identified three sites two of which were infrequently sampled (site 11, Lane Ends and site 141, Wenning) and had mean densities of class D/E ($<0.4/100m^2$). Site 115 (Chapel Beck) yielded class B densities for salmon and trout parr and the reason for its inclusion in this cluster rather than cluster 6 may be the poor density of salmon parr recorded in 1983.

Cluster 2 included 4 upper Lune subcatchment sites, about half of the Birk subcatchment and all but one of the Barbon/Leck Beck subcatchment. This cluster identified sites with mean densities of class B for 1+ salmon and class C/D for 1+ trout.

### 4.8 The Effect of Stream Width on Juvenile Salmonid Abundance

Figs. 13 to 22 show that in many cases the highest trout densities were associated with relatively small water courses. Subsequent regression analysis on the data obtained from each year (excluding 1981) revealed that a significant proportion of the variation in 0+ densities (28% to 47%) could be explained by stream width, trout density was found to decrease with increasing stream width. The following regression equations were obtained:

<u>1982</u>

$$\text{Log (0+ Trout Density)} = 5.79 - 1.74 \text{ Log (Width)}$$

$$R^2 = 47\% \qquad p < 0.0001 \text{ (Significant)}$$

<u>1983</u>

$$\text{Log (0+ Trout Density)} = 4.99 - 1.20 \text{ Log (Width)}$$

$$R^2 = 28\% \qquad p < 0.0001 \text{ (Significant)}$$

1984

Log (0+ Trout Density) = 5.07 - 1.46 Log (Width)

$R^2$ = 40% p < 0.0001 (Significant)

1985

Log (0+ Trout Density) = 4.95 - 1.38 Log (Width)

$R^2$ = 45% p < 0.0001 (Significant)

From the relationship between 0+ trout density and stream width it is inferred that habitat and flow conditions are more favourable for trout fry in the smaller water courses. The most productive sites for 0+ trout were found to be those less than 10m wide. 1+ trout distribution and abundance followed a similar pattern with a significant proportion of the variation in density being explained by stream width (22% to 37%):

1982

Log (1+ Trout Density) = 3.32 - 0.99 Log (Width)

$R^2$ = 33% p < 0.0001 (Significant)

1983

Log (1+ Trout Density) = 3.47 - 1.01 Log (Width)

$R^2$ = 37% p < 0.001 (Significant)

1984

Log (1+ Trout Density) = 3.33 - 0.86 Log (Width)

$R^2$ = 31% p < 0.001 (Significant)

1985

Log (1+ Trout Density) = 2.36 - 0.54 Log (Width)

$R^2$ = 22% p < 0.001 (Significant)

Stream width was not found to be significant with respect to the densities of 0+ salmon in the River Lune catchment. The variation in 0+ salmon densities that could be explained by stream width ranged from 0% to 2%.

When the analysis was carried out for 1+ salmon, stream width was found to be a significant factor influencing parr densities in 1982 and 1983 where 9% and 20% of the variation in densities could be accounted for. However the relationship was not significant for the 1984 and 1985 results:

1982

Log (1+ Salmon Density) = 2.29 - 0.51 Log (Width)

$R^2$ = 9%  p < 0.005 (Significant)

1983

Log (1+ Salmon Density) = 3.16 - 0.76 Log (Width)

$R^2$ = 20%  p < 0.0001 (Significant)

## 4.9 The Relationship Between Salmon and Trout Densities

### 4.9.1 0+ Salmon and 1+ Salmon

On examining salmon fry and parr data it was found that with the exception of the 1985 results there was a significant relationship between densities of 0+ salmon and 1+ salmon in the same year. This showed that as 1+ densities increased 0+ densities increased. 12% to 29% of the variation in 0+ densities could be explained by 1+ densities.

1982

Log (0+ Salmon Density) = 1.70 + 0.81 Log (1+ Salmon)

$R^2$ = 29%  p < 0.0001 (Significant)

1983

Log (0+ Salmon Density) = 1.47 + 0.59 Log (1+ Salmon)

$R^2$ = 12%  p < 0.002 (Significant)

1984

Log (0+ Salmon Density) = 0.68 + 0.69 Log (1+ Salmon)

$R^2$ = 29%  p < 0.0001 (Significant)

### 4.9.2 0+ Salmon and 0+ Trout

Regression analysis revealed that there was no significant correlation between 0+ salmon densities and 0+ trout densities over the period 1982 to 1985.

### 4.9.3 0+ Salmon and 1+ Trout

The relationship between salmon fry and trout parr was investigated and revealed no significant correlation for the data from 1982, 1984 and 1985, however a significant negative relationship was found to exist between 0+ salmon density and 1+ trout density in 1983. As trout parr density increased salmon fry density decreased. 11% of the variation in salmon fry density could be explained by the density of trout parr:

1983

Log (0+ Salmon Density) = 3.01 - 0.59 Log (1+ Trout)

$R^2$ = 11% $p < 0.003$ (Significant)

### 4.9.4 1+ Salmon and 1+ Trout

There was no significant correlation between 1+ salmon and 1+ trout densities in 1982, 1984, and 1985, however, a significant relationship was found for the 1983 data. An increase in trout density resulted in an increase in salmon density. 1+ trout densities accounted for 10% of the variation in 1+ salmon densities:

1983

Log (1+ Salmon Density) = 1.04 + 0.34 Log (1+ Trout)

$R^2$ = 10% $p < 0.005$ (Significant)

### 4.9.5 0+ Trout and 1+ Trout

The density of 0+ trout was found to be significantly correlated with the density of 1+ trout, 25% to 59% of the variation in trout fry densities could be explained by parr densities.

1982

Log (0+ Trout Density) = 0.76 + 1.12 Log (1+ Trout)

$R^2$ = 59% $p < 0.0001$ (Significant)

1983

Log (0+ Trout Density) = 1.20 + 0.88 Log (1+ Trout)

$R^2$ = 43% $p < 0.0001$ (Significant)

1984

Log (0+ Trout Density) = 0.91 + 0.75 Log (1+ Trout)

$R^2$ = 25% $p < 0.0001$ (Significant)

1985

Log (0+ Trout Density) = 0.73 + 1.09 Log (1+ Trout)

$R^2$ = 31% $p < 0.0001$ (Significant)

### 4.9.6 0+ Trout and 1+ Salmon

A significant relationship between 0+ trout and 1+ salmon was recorded for the data obtained in 1982 and 1983. It was found that 11% and 10% of the variation in 0+ trout densities could be explained by 1+ salmon densities. In these instances, as salmon parr densities increased trout fry densities also increased. No significant relationship was recorded for 1984 and 1985.

1982

Log (0+ Trout Density) = 1.31 + 0.62 Log (1+ Salmon)

$R^2$ = 11% $p < 0.004$ (Significant)

1983

Log (0+ Trout Density) = 1.64 + 0.45 Log (1+ Salmon)

$R^2$ = 10% $p < 0.005$ (Significant)

## 4.10 The Effect of Flow on Juvenile Salmonid Densities

No significant correlation was found between flow and the densities of 0+ salmon, 1+ salmon, and 1+ trout recorded in the catchment. The same was true for the majority of 0+ trout densities, however densities at two sites in the catchment were significantly correlated with flow. At site 122 (Clough) 0+ trout densities were negatively correlated with flow in July where low flow was associated with high densities. A positive correlation was obtained for February where low flow was associated with low 0+ trout density recorded in the survey period. At site 21 (Wath) there was a significant inverse correlation between flow and densities in August, low flow being associated with high densities.

## 5. Discussion

The observed patterns of distribution and abundance of fish in the River Lune may be linked to a variety of abiotic and biotic factors such as water quality, habitat, flow regimes, competition, stocking, and in the case of anadromous fish access to spawning grounds.

Water quality results indicate that the Lune is a class 1 river, however, small scale intermittent pollution may have occurred over the 1981 to 1985 period, but there are no records to substantiate this. A more recent biology survey has shown Rais Beck (site 106) and Chapel Beck (site 108) to be susceptible to organic enrichment (Saxby, 1991).

The most productive areas of the catchment for salmon were the upper Lune and its tributaries (subcatchment 1), Barbon Beck/Leck Beck (subcatchment 10), Chapel Beck/Croasdale Beck (subcatchment 6) and Birk Beck/Borrowdale Beck (subcatchment 5). There was some evidence to suggest that the observed densities at some of the sites in these subcatchments (and at other sites in the Lune catchment) may have been influenced by the stocking of fry and ova. This was self evident at those sites which were in areas inaccessible to migratory salmonids (e.g. site 111 on Birk Beck and site 130 on Barbon Beck), but required a certain degree of interpretation in instances where natural production may have been high regardless of the proximity to a stocked zone. Studies on the fate of stocked juvenile salmonids have shown that fry can move distances of up to 800m upstream of the stocked zone (Heggenes and Borgstrom, 1991) and 600m downstream of the stocked zone (Egglishaw and Shackley, 1980). In these studies most of the redistribution of the fish took place during the first 3 to 4 months. The degree of emigration was associated with habitat and planting density in the stocked zone, and with habitat and density of fish in adjacent reaches.

The density of juvenile salmon at site 132 on Leck Beck may be determined by the nature of the obstacles downstream of this site - 1 weir, 2 bridge aprons and 2 waterfalls (Fig. 1). If these obstructions were having a significant effect in limiting the number of spawning salmon reaching site 132 then substantial differences in densities could be expected between this site and site 131 which is downstream of the obstructions. Figs. 2, 4 to 12 show that this was not necessarily the case and in some instances higher densities (up to class B) were recorded at site 132. No stocking took place at these sites. This beck is susceptible to flash floods (Jeff Burton pers. comm.) hence flow and its effect on habitat may be more important than obstructions in influencing salmon densities. Hume and Parkinson (1987) observed that floods can be an important source of mortality in salmonid streams. Experimental studies by Heggenes and Traaen (1988) have demonstrated that newly emerged salmonid fry are susceptible to 'wash out' and downstream displacement during increased water velocities.

In Borrowdale Beck migratory fish may be partially impeded by a waterfall (Fig. 1) but some fish are able to penetrate the upper reaches as indicated by the presence of adult sea trout upstream of site 114, the largest of which was 57.5cm (Farooqi and Aprahamian, 1992).

Subcatchments 11 (Greta), 9 (Dee) and 7 (Rawthey) fall into an intermediate group of sites with highly variable densities, often producing good year classes of 0+ and 1+ salmon. The known obstructions on the River Greta consist of 9 waterfalls and 1 weir the majority of which are upstream of site 136 (Fig. 1). The importance of the first 2 waterfalls on the Greta in terms of their effectiveness as barriers to adult salmon needs further study. In the absence of any stocking, site 133 (downstream of the obstructions) produced densities of salmon comparable to sites 134 to 136 which are upstream of the waterfalls (Figs. 1, 2, 4 to 12). It appears that the combination of a total of 7 waterfalls and 1 weir downstream of sites 137, 137a and 138 effectively prevents the successful upstream migration of adult salmon. These sites registered as class E over the whole of the study period with the exception of site 138 where a parr density of class D was recorded in 1983. This can be attributed to the stocking of 10,000 fry in the vicinity of site 138 in 1982.

The Dee (subcatchment 9) and Rawthey (subcatchment 7) have no known obstacles that would have influenced juvenile salmon densities at the survey sites. However, it is known that large areas of the Dee upstream of site 126 are prone to drying up in summer (A. Atkinson pers. comm.). There was no evidence from the results to suggest that the densities of salmon (and trout) at sites 126 and 127 were less than that recorded at the downstream sites 124 and 125.

It is clear from the results of this survey that the Wenning (subcatchment 12) is not conducive to the production of juvenile salmon. This was also true of the Hindburn/Roeburn system (subcatchment 13) and Clough (subcatchment 8) which were sparsely populated by juvenile salmon. In the latter case this may be due to the limited availability of suitable habitat.

In the case of the Wenning and the Hindburn/Roeburn all the historical data (including the 1991 survey, Farooqi and Aprahamian, 1992) indicates that these systems invariably produce low densities of salmon. From the data available there is no indication of a decline in juvenile salmon production in these systems but consistent low productivity. In this respect the availability of suitable habitat may be an important factor in determining the carrying capacity of the system. In conjunction with this, obstructions to upstream migration namely waterfalls and the weir upstream of the Lune confluence (Fig. 1) may be limiting the number of spawning fish entering the Wenning and Hindburn systems. Two further weirs on the Wenning may also be having a similar effect in reducing the number of adults reaching the upper tributaries of the Wenning.

The extent to which the barriers on the Wenning regulate the upstream passage of migratory fish is not known, but from an examination of Figs. 1, 2, 4 to 12 it is apparent that some adult salmon are able to negotiate these obstructions since fry and parr are present upstream of these obstacles. The results show that the region containing sites 140 to 143 may be unfavourable for salmon production (predominantly class D/E) and this could be due to a lack of suitable habitat. Some support for this is provided by the enhancement stocking programme. Sites 141 to 143 of the Wenning were stocked with 80,000 fry in 1982 and the density categories recorded at these sites post stocking were class D for site 141 and class E for site 142 and 143. Parr production in 1983 registered as class E at all three sites.

Sites 144 and 145 on the Wenning were predominantly class D. The region incorporating these sites was stocked with 80,000 fry in 1982 but registered as class D in the following fry survey. Parr densities in 1983 were class C and may have been enhanced by stocking suggesting that this particular section may not be at its carrying capacity as a result of insufficient numbers of adults being able to negotiate the obstructions to reach this area.. However, the significance of this result is not clear since a similar stocking exercise involving 50,000 fry in the vicinity of site 145 in 1983 showed that fry and subsequent parr densities were class D. Clearly, without an indication of stocking densities it becomes difficult to interpret these findings since the stocking of fry over a large area may be insufficient to increase abundance from one density category to another.

Site 153 of the Wenning (Keasden Beck) was class E on all sampling occasions and site 152 (Fenn Beck) produced similar results except for 0+ salmon in 1982. Fry and parr were present upstream and downstream of the confluence of these becks with the Wenning, and since there are no known obstacles to adult salmon specific to these becks, the implications are that habitat or water quality may be important factors in determining juvenile salmon production.

Salmon densities were predominantly class D at sites 148 (Clapham Beck) and 149 to 151 (Austwick Beck) on the upper Wenning tributaries (although maximum densities of class C were obtained). These areas were relatively productive for trout, the population of which is known to have an anadromous component (J. Burton pers. comm.). Interspecific competition may be an important factor at these sites. Interspecific competition from brown trout has been found to affect growth and survival of young salmon (Kennedy and Strange, 1986; Egglishaw and Shackley 1980, 1985) because they are territorial and generally thought to be more aggressive than salmon (Le Cren, 1965).

Gardiner's (1989) study on the Tweed catchment showed pronounced differences in juvenile salmon densities commonly coincide with the presence of obstacles, even those that appeared to be minor ones. The densities of juveniles upstream of obstacles were found to be lower than at other sites. Site

139 on the Wenning is downstream of the obstructions on that system but was predominantly class D thus making it difficult to evaluate the effectiveness of the weirs as barriers to adult salmon since the unimpacted site should in theory support higher densities than the impacted sites. The habitat may not be suitable for high densities of salmon at site 139. It seems that the availability of suitable habitat and the presence of obstacles are two of the key factors influencing juvenile salmon densities in the River Wenning, however on the basis of these results it is not possible to determine which of these factors is the more significant. An increase in the number of adult salmon entering the Wenning system would not necessarily result in a significant improvement in the overall density characteristics of the subcatchment because habitat and/or biotic factors may still operate in a large part of the subcatchment, particularly between sites 139 to 143 and in the upper Wenning tributaries (sites 148 to 153).

The presence of obstructions and the availability of habitat are also implicated as factors determining juvenile salmon densities in the Hindburn/Roeburn system. Any fish negotiating the first weir on the Wenning (Fig. 1) should have access to sites 157 and 158 on the Roeburn based on current knowledge of instream obstructions. Site 157 registered predominantly as class D/C while site 158 was class E for most of the study period. The two waterfalls on the Hindburn may be acting as an effective barrier to adult salmon since no juveniles were recorded at sites 155 and 156 during the 1981 to 1985 period while densities at the downstream site (154) were predominantly class D. The Hindburn/Roeburn subcatchment is a relatively productive trout system, particularly sites 155, 156 and 158. It is postulated that interspecific competition and habitat influences salmon production at site 158 while the waterfalls on the Hindburn limit salmon production at sites 155 and 156.

The lower Lune (subcatchment 4), lower middle Lune (subcatchment 3), and to some extent the upper middle Lune (subcatchment 2) supported relatively low 0+ salmon densities, but the main feature of these subcatchments is the very low productivity of 1+ salmon. This may be as a result of the difficulties involved in the sampling of main river sites where parr can evade capture (Gardiner, 1984; Heggenes 1990).

From an examination of the data pertaining to site means and coefficient of variation (Tables 2 to 5) it is possible to identify those sites which contributed most to juvenile salmon production in the Lune catchment over the period 1981 to 1985 and these are shown in Table 6. It was noticeable that the best sites for 0+ production were not necessarily the best sites for 1+ production when taking into account the variability about the mean.

Table 6 A list of the most productive sites for salmon in the Lune catchment based on mean site densities and coefficient of variation (CV), 1981 - 1985

| Sub-catchment | Site | Mean ($N/100m^2$) | CV | Density Class |
|---|---|---|---|---|
| | 0+ Salmon | | | |
| 10 | Barbon Beck (129) | 66.7 | 54.9 | B |
| 9 | Dee (125) | 51.0 | 47.0 | B |
| 6 | Chapel Beck (115) | 66.8 | 60.0 | B |
| 1 | Tebay (17) | 42.7 | 43.0 | C |
| 1 | Old Tebay Br. (18) | 51.2 | 59.5 | B |
| 1 | Rayne Br. (19) | 55.8 | 44.2 | B |
| 1 | Kelleth Br. (20) | 43.8 | 38.8 | C |
| 1 | Wath (21) | 41.7 | 59.3 | C |
| | 1+ Salmon | | | |
| 10 | Barbon Beck (130) | 19.8 | 61.3 | B |
| 10 | Leck Beck (132) | 11.9 | 42.6 | B |
| 7 | Sedbergh (118) | 21.8 | 70.1 | A |
| 5 | Borrowdale Beck (113) | 12.4 | 13.8 | B |
| 5 | Borrowdale Beck (114) | 18.0 | 28.9 | B |
| 1 | Kelleth Br. (20) | 15.3 | 31.5 | B |
| 1 | Tebay Gill (107) | 44.4 | 76.5 | A |

With respect to the trout population there was considerable variation in densities within the catchment, but some patterns of distribution and abundance were evident. The main river subcatchments 4 (lower Lune), 3 (lower middle Lune) and 2 (upper middle Lune) were virtually devoid of juvenile trout while subcatchments 12 (Wenning), 11 (Greta), 10 (Barbon Beck/Leck Beck), 9 (Dee), 7 (Rawthey) and 5 (Birk Beck/Borrowdale Beck), although highly variable supported some good populations of trout. The most productive areas were found to be subcatchments 6 (Chapel Beck/Croasdale Beck), 1 (upper Lune and its tributaries), 13 (Hindburn/Roeburn) and 8 (Clough). As was the case for salmon the best sites for 0+ production were not necessarily the same for 1+ production.

There was some evidence from the River Lune stock assessment survey (Farooqi and Aprahamian, 1992) to suggest that the distribution of trout fry was related to the size of the water course. The results of the regression analysis showed that for 0+ and 1+ trout a significant amount of the variation in densities could be explained by the width of the water course. Small streams are likely to provide conditions which are more favourable for the production of high densities of trout than larger streams where the only suitable trout habitat may be associated with the margins. Nicholson (1987) found that 45.6% of variation in 0+ trout density for streams of up to 8m wide could be explained by stream width alone, and for 1+ trout in

streams of widths up to 9m the relationship was stronger ($R^2$ = 67.7%). Gardiner (1989) showed that substrate type, stream width and alkalinity accounted for almost half the variation in trout fry densities. In the case of trout of 1+ and older, stream width, alkalinity, substrate type and presence/absence of obstacles accounted for 70% of the variation in densities. As a result of this pattern of distribution low densities of trout may be recorded at wide sites whereas densities may in fact be appropriate for the amount of suitable habitat available.

The most productive sites for juvenile trout based on mean site densities and coefficient of variation are shown in Table 7. Site 116 on Croasdale Beck was quite exceptional with respect to the mean density recorded and the low CV making it one of the most important trout nursery streams in the Lune catchment.

Table 7 A list of the most productive sites for trout in the Lune catchment based on mean site densities and coefficient of variation (CV), 1981 - 1985

| Sub-catchment | Site | Mean ($N/100m^2$) | CV | Density Class |
|---|---|---|---|---|
| | 0+ Trout | | | |
| 12 | Austwick Beck (151) | 138.6 | 48.3 | A |
| 6 | Croasdale Beck (116) | 426.6 | 17.9 | A |
| 6 | Chapel Beck (115) | 56.8 | 76.8 | B |
| 5 | Bretherdale Beck (112) | 46.4 | 32.3 | C |
| 5 | Borrowdale Beck (114) | 33.2 | 43.0 | C |
| 1 | Bowderdale Beck (103) | 43.4 | 52.6 | C |
| | 1+ Trout | | | |
| 13 | Hindburn (156) | 19.2 | 38.7 | B |
| 13 | Hindburn (155) | 12.2 | 43.5 | B |
| 6 | Chapel Beck (115) | 17.0 | 58.8 | B |
| 6 | Croasdale Beck (116) | 31.4 | 60.1 | A |

The analysis of site mean density and the coefficient of variation showed that sites with low CV were likely to be those with high densities of juvenile salmonids and these are likely to be regulated by density dependent processes (Elliott, 1992). These results may be useful when establishing a policy of enhancement stocking by selecting against those sites with low CV and planting in those areas where density independent factors are more important in determining juvenile salmonid population densities.

An important consideration with respect to the survival of fry is flow. Low flows can result in increased predation by

reducing the available habitat and cover. It can also act by increased temperature effects. It is known that the upper reaches of the Dee (subcatchment 9) experience such conditions. With respect to the Lune data however, there was no discernible effect of flow on the densities of young of the year trout or salmon (with the exception of two sites).

1980 was the year in which the net limitation order was put into effect. If we were to assume that there was little natural variation in juvenile salmon production and that exploitation was a limiting factor then an improvement in 0+ productivity in 1981 and consequently increased 1+ productivity in 1982 would be anticipated. In addition stronger year classes of 0+ and 1+ salmon could reasonably be expected in subsequent years since the proportion being recruited to the adult population would theoretically have increased. 0+ productivity was in fact relatively low in 1981 but the population estimates should be considered as minimum estimates for the reason outlined earlier. There was an improvement in subsequent years, especially 1982 and 1983. Compared to the former years 1984 was a relatively unproductive year for 0+ salmon. The subcatchments Wenning, Hindburn/Roeburn and Clough were low productivity systems. Salmon densities in the main river (subcatchments 2, 3, 4) were very variable and although some quite good year classes were produced on occasions the overall conclusion is that there was no noticeable increase in productivity from 1982.

In general, 1+ densities in 1982 and 1985 were relatively lower than that recorded in 1981. The higher densities observed in 1983 and 1984 reflect the fact that the strongest 0+ year classes were produced in 1982 and 1983.

In order to fully assess the implications of the restriction on fishing, juvenile salmonid data from the period prior to the implementation of the restriction would be required and this is not available.

If Elson and Toumi's (1975) average density for pre-smolt parr of 10-15/100m$^2$ is taken as a standard for a recognised salmon stream (equivalent to class B under the NW region classification system) then it appears that the Lune falls short of this standard (Table 8). The availability of suitable habitat and the presence of instream obstructions may be important factors in this respect. The most productive year for pre-smolt parr was 1984 with 35.5% of the sites sampled having densities greater than 10/100m$^2$.

Table 8 The percentage of Lune sites with 1+ salmon densities greater than 10/100m$^2$ over the period 1981 to 1985

| Year | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|
| % Of Sites | 21.5 | 14.1 | 19.5 | 35.5 | 9.8 |

The catchment profiles for 0+ salmon over the 1981 to 1985 period show some distinct patterns which are also evident in the results of the 1991 Lune survey (Farooqi and Aprahamian, 1992) such as the low productivity of the Clough (subcatchment 8), Greta (subcatchment 11), tributaries of the Wenning (subcatchment 12), and Hindburn/Roeburn (subcatchment 13). The most productive areas were identified as the upper Lune and its tributaries (subcatchment 1), Birk Beck/Borrowdale Beck (subcatchment 5), Chapel Beck/Croasdale Beck (subcatchment 6) and Barbon Beck/Leck Beck (subcatchment 10). Low densities of salmon parr were recorded in the lower Lune (subcatchment 4) and lower middle Lune (subcatchment 3) but this is likely to be an artifact of the sampling technique.

From Fig. 32 it can be seen that the percentage of sites classified as A, B, C, D and E for juvenile salmon and trout in 1991 is comparable to that of the 1981 to 1985 data. With respect to 0+ salmon the most productive years were 1982, 1983 and 1991. Parr production in 1991 was not as high as in the years 1981 and 1984, but was comparable to that recorded in 1982 and 1983.

The highest densities of trout were produced from subcatchments 1 (upper Lune and its tributaries), 6 (Chapel Beck/Croasdale Beck), 8 (Clough), 10 (Barbon Beck/Leck Beck), 12 (tributaries of the Wenning only) and 13 (Hindburn/Roeburn) between the years 1981 to 1985 and this pattern was also evident in the results of the 1991 survey. The upper middle Lune (subcatchment 2), lower middle Lune (subcatchment 3) and lower Lune (subcatchment 4) produced low densities of trout throughout this period and it is likely that this is a habitat related effect.

1983, 1984 and 1991 were the years in which high 0+ trout density sites (i.e. class A and B) were more prevalent in addition to having the highest percentage of sites in the density range A to C. Parr production was at its highest in the years 1982, 1983 and 1984. The only difference between the 1981, 1985 and 1991 results was that the latter had a greater percentage of sites in the density range of class A to C.

Gardiner (1989) noted a weak relationship between salmon and trout densities, with high numbers of trout associated with lower numbers of salmon. On examination of the 0+ salmon and trout data it was found that sites 101 (Weasdale Beck) and 105

FIG. 32 DENSITY CHARACTERISTICS
0+ SALMON

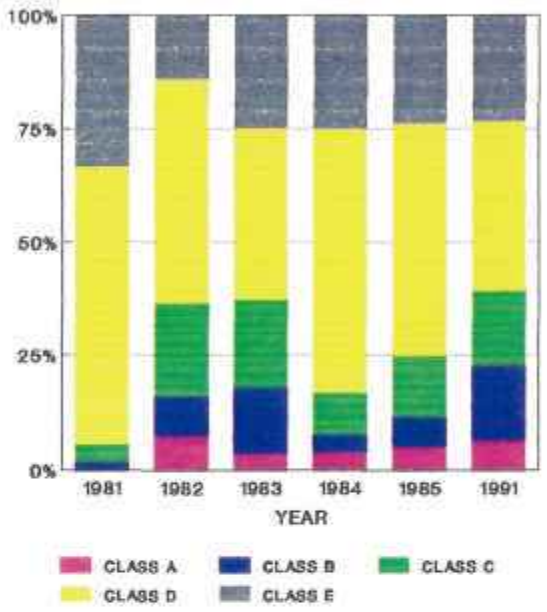



FIG. 32 DENSITY CHARACTERISTICS
1+ SALMON

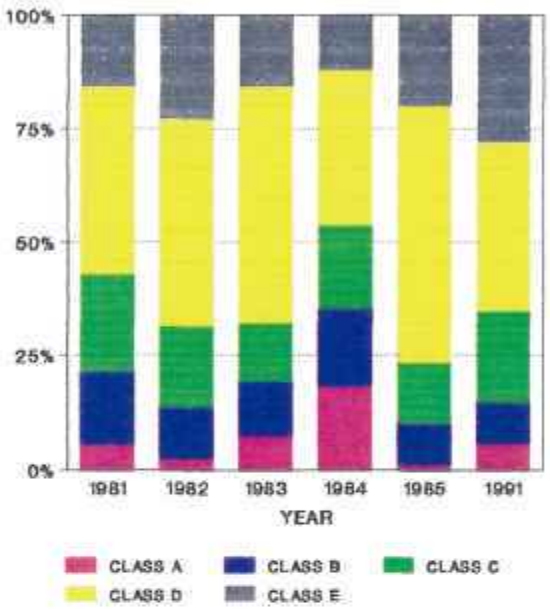



FIG. 32 DENSITY CHARACTERISTICS
0+ TROUT

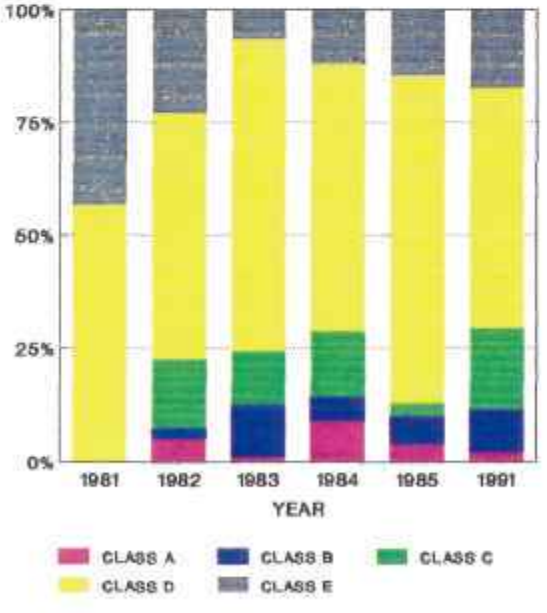
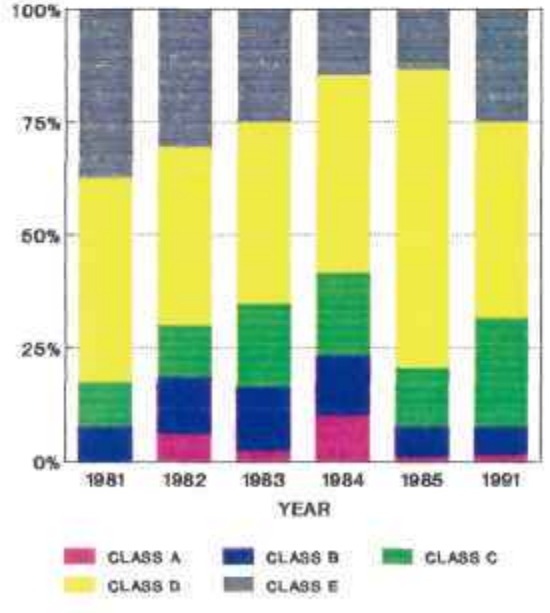



FIG. 32 DENSITY CHARACTERISTICS
1+ TROUT



(Ellergill Beck) produced high densities of 0+ trout and low densities of 0+ salmon. Conversely, site 128 (Barbon Beck) produced high densities of 0+ salmon and low densities of 0+ trout. However, for the catchment as a whole regression analysis showed that this type of relationship was not significant. The 1+ data for salmon and trout showed sites 104 (Longdale Beck) and 107 (Tebay Gill) to be more productive for salmon parr than trout parr. In the case of Tebay Gill this is linked to the enhancement stocking that was carried out in this beck during the survey period. 8 sites were identified as being characterised by low 1+ salmon densities and relatively high trout parr densities. These included sites 122, 123 of the Clough and sites 155, 156, 157 of the Hindburn/Roeburn. Croasdale Beck (site 116) was identified as highly productive for salmon and trout parr. Analysis of salmon and trout parr densities showed no significant relationship for the results of 1982, 1984 and 1985. For the 1983 data however, a significant relationship was found, but only 10% of the variation in 1+ salmon densities could be explained by 1+ trout densities.

There was found to be a significant relationship between 0+ and 1+ salmon densities and this showed that as 1+ densities increased 0+ densities increased. This is probably an indication of the suitability of these sites for rearing juvenile salmon.

No significant relationship was found between 0+ salmon and 1+ trout for the results obtained in 1982 ,1984 and 1985, however a significant negative correlation was recorded for 1983 where 11% of the variation in salmon fry density could be explained by 1+ trout density. Thus as 1+ trout density increased 0+ salmon density decreased. This may be an indication of the difference in habitat preferences of the two species.

The density of 0+ trout was found to be significantly correlated with the density of 1+ trout, an increase in parr densities was associated with an increase in fry densities. This indicates the suitability of the sites sampled for rearing trout. This can also be viewed in light of the fact that high 0+ and 1+ trout density sites were correlated with stream width hence good densities of trout are likely at the same sites.

The relationship between 0+ trout and 1+ salmon was examined and found to be significantly correlated for the 1982 and 1983 data but only 11% and 10% of the variation in trout fry densities could be explained by salmon parr densities.

Cluster analysis proved to be a useful and quick method of examining large data sets of this nature and provided a summary of the results over the whole of the study period. From the results it can be seen that a number of sites from a particular subcatchment and even groups of sites from other subcatchments tended to appear in the same cluster. Gardiner (1989) found that nearby sites tended to have more similar densities of salmon fry than those further apart. Having established the characteristics of the cluster a sampling

strategy can be devised whereby only a few sites from within the cluster need be surveyed, the results of which can be taken as representative for all the sites in the cluster. This would save on time and resources. Many of the sites in this study were contained in cluster 1 and if we were to undertake a similar study of the Lune then it would be feasible to reduce the number of sites that need to be sampled from cluster 1.

## 6. Conclusion

The results of the 1981 to 1985 and 1991 surveys have identified certain features which are characteristic of salmonid production in the catchment. The most productive areas for juvenile salmon were found to be the upper Lune and its tributaries (subcatchment 1), Birk Beck/Borrowdale Beck (subcatchment 5) and Barbon Beck/Leck Beck (subcatchment 10). Other areas of the catchment namely the Greta (subcatchment 11), Wenning (subcatchment 12) and Hindburn/Roeburn (subcatchment 13), were found to be relatively unproductive for juvenile salmon and it is suggested that this may be a habitat/obstruction related phenomenon. Relatively low densities of salmon parr were recorded in subcatchments 2 (upper middle Lune), 3 (lower middle Lune) and 4 (lower Lune) of the main river and this may have been due to the difficulties associated with sampling deep fast flowing areas of water.

There was sufficient evidence to suggest that enhancement stocking has been quite successful in some areas particularly those where barriers to adult salmon exist.

Although well distributed throughout the catchment 0+ and 1+ trout densities were low overall, however certain areas were very productive such as Austwick Beck (subcatchment 12), Chapel Beck/Croasdale Beck (subcatchment 6) and Hindburn/Roeburn (subcatchment 13). It seems that trout have certain preferences for habitat which are only met in parts of the catchment i.e water courses with mean widths less than 10m. Juvenile trout production was quite prolific at some of these sites. Thus in a comprehensive survey of a large river system such as the Lune the overall density characteristics of the catchment for juvenile trout will be determined by the number of sampling sites greater than 10m.

## 7. Recommendations

(1) To investigate the reasons for the low productivity of the Wenning and Hindburn/Roeburn systems for salmon. This could be achieved by carrying out stocking experiments in areas upstream and downstream of the obstructions. This would indicate the extent to which obstructions and habitat determine the productivity of the system. A similar study may be required for the Greta.

(2) The methods used to assess juvenile trout densities in large rivers needs to be reviewed to take account of the fact that trout densities in the River Lune are highly correlated with stream width.

## 8. Acknowledgements

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Appendix 1. The Subcatchments of the River Lune 1981-1985

1981

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) | ACCESSIBLE |
|---|---|---|---|---|---|---|---|
| 1 | 21 | Lune Wath | NY 680052 | 7.00 | 35.0 | 245.0 | ✓ |
| | 20 | Lune Kelleth Br. | NY 661051 | 10.00 | 50.0 | 500.0 | ✓ |
| | 19 | Lune Rayne Br. | NY 644056 | 10.00 | 33.0 | 330.0 | ✓ |
| | 18 | Lune u/s Tebay Br. | NY 622056 | 18.00 | 50.0 | 900.0 | ✓ |
| | 103A | Bowderdale | NY 677044 | 5.00 | 45.0 | 225.0 | ✓ |
| | 104A | Longdale | NY 643051 | 6.00 | 50.0 | 300.0 | ✓ |
| 2 | 15 | Lune Fairmile | SD 625988 | 28.00 | 60.0 | 1680.0 | ✓ |
| | 14 | Lune Fleetholme | SD 625968 | 28.00 | 31.0 | 868.0 | ✓ |
| | 12 | Lune Lincolns Br. | SD 632924 | 36.00 | 27.0 | 972.0 | ✓ |
| 3 | 10 | Lune d/s Killington Beck | SD 625882 | 35.00 | 50.0 | 1750.0 | ✓ |
| | 9 | Lune Middleton Hall | SD 622867 | 59.00 | 55.0 | 3245.0 | ✓ |
| | 7 | Lune u/s Underley Br. | SD 608808 | 58.00 | 50.0 | 2900.0 | ✓ |
| | 6 | Lune Kirkby Island | SD 617787 | 29.00 | 58.0 | 1682.0 | ✓ |
| 4 | 5 | Lune Whittington | SD 609756 | 41.00 | 43.0 | 1763.0 | ✓ |
| | 4 | Lune Newton | SD 601742 | 57.00 | 23.0 | 1311.0 | ✓ |
| | 3 | Lune Gressingham | SD 578703 | 34.00 | 67.0 | 2278.0 | ✓ |
| | 2 | Lune Snab | SD 564676 | 31.00 | 42.0 | 1302.0 | ✓ |
| | 1 | Lune Caton | SD 540653 | 43.00 | 62.0 | 2666.0 | ✓ |
| 5 | 109 | Birk B. d/s Bretherdale | NY 602054 | 10.00 | 35.0 | 350.0 | |
| | 110A | Birk B. Greenholme | NY 596067 | 12.00 | 53.0 | 636.0 | |
| | 113 | Borrow B. Wood BR. | NY 586011 | 7.00 | 50.0 | 350.0 | ✓ |
| | 114A | Borrow B. Low Borrow Fm. | NY 581019 | 12.00 | 50.0 | 600.0 | ✓ |
| 6 | 120 | Rawthey Low Haygarth Fm. | NY 696968 | 10.00 | 35.0 | 350.0 | ✓ |
| | 1198 | Rawthey Cautley Church | SD 693956 | 9.00 | 48.0 | 432.0 | ✓ |
| | 118 | Rawthey Sedbergh | SD 663918 | 10.00 | 37.0 | 370.0 | ✓ |
| | 117 | Rawthey Ingmire | SD 638912 | 28.00 | 42.0 | 1176.0 | |
| 8 | 123A | Clough Garsdale | SD 735898 | 7.00 | 54.0 | 378.0 | |
| | 122A | Clough New Br. | SD 714906 | 10.00 | 57.0 | 570.0 | |
| | 121 | Clough Farfield Mill | SD 682918 | 10.50 | 55.0 | 577.5 | |
| 9 | 127 | Dee Dent | SD 707873 | 10.00 | 42.0 | 420.0 | |
| | 126 | Dee Bath Br. | SD 695878 | 10.00 | 50.0 | 500.0 | |
| | 125 | Dee Wood Br. | SD 678887 | 9.00 | 25.0 | 225.0 | |
| | 124 | Dee Rash Mill | SD 657902 | 11.00 | 42.0 | 462.0 | |
| 10 | 129 | Barbon B. Upper | SD 622826 | 9.50 | 56.0 | 532.0 | |
| | 128 | Barbon B. Lower | SD 613818 | 8.50 | 44.0 | 374.0 | |
| | 132 | Leck B. Overtown | SD 632765 | 6.00 | 33.0 | 198.0 | |
| | 131 | Leck B. Above Burrow | SD 615756 | 9.00 | 60.0 | 540.0 | |
| 11 | 136A | Greta Ingleton | SD 694732 | 12.00 | 46.0 | 552.0 | |
| | 135 | Greta Falcon Fm. | SD 666716 | 12.00 | 42.0 | 504.0 | |
| | 134 | Greta Burton in Lonsdale | SD 655720 | 10.00 | 48.0 | 480.0 | |
| | 133 | Greta Greta Br. | SD 610726 | 12.00 | 56.0 | 672.0 | |
| 12 | 148 | Wenning Clapham B. | SD 744687 | 7.00 | 57.0 | 399.0 | |

Appendix 1. (Cont.)

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 12 | 146A | Wenning Clapham Station | SD 733677 | 12.00 | 43.0 | 516.0 |
| | 145 | Wenning Greystonegill Br. | SD 694683 | 9.00 | 66.0 | 594.0 |
| | 140 | Wenning Wennington | SD 615702 | 23.00 | 64.0 | 1472.0 |
| | 139 | Wenning Hornby | SD 584684 | 16.00 | 60.0 | 960.0 |
| 13 | 156 | Hindburn Top | SD 651639 | 3.20 | 46.0 | 147.2 |
| | 155 | Hindburn Furness Ford Br. | SD 635668 | 11.00 | 50.0 | 550.0 |
| | 154A | Hindburn Hindburn Br. | SD 614676 | 10.00 | 50.0 | 500.0 |
| | 158A | Roeburn Top | SD 601638 | 8.00 | 57.0 | 456.0 |
| | 157 | Roeburn Wray | SD 604672 | 8.00 | 50.0 | 400.0 |

1982

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) | 81 83 84 85 91 92 |
|---|---|---|---|---|---|---|---|
| 1 | 21 | Lune Wath | NY 680052 | | | 96.0 | ✓ |
| | 20 | Lune Kelleth Br. | NY 661051 | 6.00 | 25.0 | 150.0 | ✓ |
| | 19 | Lune Rayne Br. | NY 644056 | 8.00 | 33.0 | 264.0 | ✓ |
| | 18 | Lune u/s Tebay Br. | NY 622056 | 10.00 | 35.0 | 350.0 | ✓ |
| | 17 | Lune Tebay | NY 613044 | 18.00 | 35.0 | 630.0 | ✗ |
| | 101 | Weasdale | NY 690048 | 2.00 | 27.0 | 54.0 | ✗ |
| | 102 | Bowderdale Bottom | NY 678050 | 4.00 | 44.0 | 176.0 | ✗ |
| | 103 | Bowderdale | NY 676041 | 5.00 | 30.0 | 150.0 | ✗ |
| | 104 | Longdale | NY 644047 | 6.00 | 40.0 | 240.0 | ✗ |
| | 105 | Ellergill | NY 639049 | 4.00 | 34.0 | 136.0 | ✗ |
| | 106 | Rais B. | NY 637065 | 4.00 | 34.0 | 136.0 | ✗ |
| | 107 | Tebay Gill | NY 622034 | 4.00 | 32.0 | 128.0 | ✗ |
| | 108 | Chapel B. Orton | NY 622062 | 6.00 | 23.0 | 138.0 | ✗ |
| 2 | 16 | Lune Yorkshire Br. | NY 612008 | 20.00 | 30.0 | 600.0 | ✗ |
| | 15 | Lune Fairmile | SD 625988 | 16.00 | 30.0 | 480.0 | ✓ |
| | 14 | Lune Fleetholme | SD 625968 | 25.00 | 39.0 | 975.0 | ✓ |
| | 13 | Lune Thwaites | SD 629948 | 15.00 | 30.0 | 450.0 | ✗ |
| | 12 | Lune Lincolns Br. | SD 632924 | 17.00 | 20.0 | 340.0 | ✓ |
| | 11 | Lune Four lane ends | SD 623898 | 20.00 | 20.0 | 400.0 | ✗ |
| 3 | 10 | Lune d/s Killington Beck | SD 625882 | 26.00 | 49.0 | 1274.0 | ✓ |
| | 9 | Lune Middleton Hall | SD 622867 | 16.00 | 38.0 | 608.0 | ✓ |
| | 8 | Lune Rigmaden | SD 616847 | 17.00 | 40.0 | 680.0 | ✗ |
| | 7 | Lune u/s Underley Br. | SD 608808 | 28.00 | 30.0 | 840.0 | ✓ |
| | 6 | Lune Kirkby Island | SD 617787 | 13.00 | 25.0 | 325.0 | ✓ |
| 4 | 5 | Lune Whittington | SD 609756 | 37.00 | 40.0 | 1480.0 | ✓ |
| | 4 | Lune Newton | SD 601742 | 30.00 | 18.0 | 540.0 | ✓ |
| | 3 | Lune Gresssingham | SD 578703 | 27.00 | 54.0 | 1458.0 | ✓ |
| | 2 | Lune Snab | SD 564676 | 25.00 | 40.0 | 1000.0 | ✓ |
| | 1 | Lune Caton | SD 540653 | 16.00 | 34.0 | 544.0 | ✓ |
| 5 | 109 | Birk B. d/s Bretherdale | NY 600056 | 14.00 | 29.0 | 406.0 | ✗ |
| | 110 | Birk B. Scout Green | NY 594075 | 11.00 | 37.0 | 407.0 | ✗ |

Appendix 1. (Cont.)

| Subcatchment | Site | Site Name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 5 | 111 | Birk B. Shap Well | NY 582096 | 7.00 | 43.0 | 301.0 |
| | 112 | Bretherdale u/s Birk B. | NY 597051 | 6.50 | 27.0 | 175.5 |
| | 113 | Borrow B. Low Borrow Br. | NY 586012 | 8.00 | 25.0 | 200.0 |
| | 114 | Borrow B. Wood Br. | NY 575023 | 6.00 | 30.0 | 180.0 |
| 6 | 115 | Chapel B. Above Lune | SD 632948 | 2.50 | 30.0 | 75.0 |
| | 116 | Crossdale B. | SD 637936 | 2.00 | 15.0 | 30.0 |
| 7 | 120 | Rawthey Low Haygarth Fm. | NY 695968 | 15.00 | 42.0 | 630.0 |
| | 119 | Rawthey Burnt Mill | SD 692953 | 10.00 | 30.0 | 300.0 |
| | 118 | Rawthey Sedbergh | SD 663916 | 10.00 | 40.0 | 400.0 |
| | 117 | Rawthey Ingmire | SD 638911 | 18.00 | 30.0 | 540.0 |
| 8 | 123 | Clough Top | SD 730900 | 6.00 | 20.0 | 120.0 |
| | 122 | Clough New Br. | SD 717906 | 6.00 | 35.0 | 210.0 |
| | 121 | Clough Farfield Mill | SD 683917 | 10.00 | 45.0 | 450.0 |
| 9 | 127 | Dee Dent | SD 708872 | 9.00 | 35.0 | 315.0 |
| | 126 | Dee Bath Br. | SD 693879 | 7.00 | 33.0 | 231.0 |
| | 125 | Dee Wood Br. | SD 675889 | 13.00 | 21.0 | 273.0 |
| | 124 | Dee Rash Mill | SD 657902 | 15.00 | 37.0 | 555.0 |
| 10 | 130 | Barbon B. Top | SD 658832 | 7.00 | 34.0 | 238.0 |
| | 129 | Barbon B. Middle | SD 623824 | 8.00 | 28.0 | 224.0 |
| | 128 | Barbon B. Lower | SD 613818 | 3.00 | 30.0 | 90.0 |
| | 132 | Leck B. Top | SD 629764 | 5.00 | 36.0 | 180.0 |
| | 131 | Leck B. Leck B. Br. | SD 616757 | 8.50 | 38.0 | 323.0 |
| 11 | 138 | Kingsdale B. | SD 695760 | 6.00 | 50.0 | 300.0 |
| | 137 | Doe Dale House | SD 720758 | 8.00 | 40.0 | 320.0 |
| | 136 | Greta Ingleton | SD 687727 | 10.00 | 25.0 | 250.0 |
| | 135 | Greta Falcon fm. | SD 668717 | 7.00 | 40.0 | 280.0 |
| | 134 | Greta Burton in Lonsdale | SD 655720 | 11.00 | 34.0 | 374.0 |
| | 133 | Greta Greta Br. | SD 609728 | 8.00 | 39.0 | 319.0 |
| 12 | 153 | Keasden B. | SD 717666 | 4.00 | 30.0 | 120.0 |
| | 152 | Fen B. Fen B. Br. | SD 754668 | 4.00 | 36.0 | 144.0 |
| | 151 | Austwick B. Harden Br. | SD 761678 | 4.50 | 28.0 | 126.0 |
| | 150 | Austwick B. Waters Br. | SD 749676 | 7.50 | 44.0 | 330.0 |
| | 149 | Austwick/Fen Confluence | SD 746673 | 9.00 | 21.0 | 189.0 |
| | 148 | Wenning Clapham B. | SD 744685 | 7.00 | 39.0 | 273.0 |
| | 147 | Wenning | SD 742674 | 12.00 | 17.0 | 204.0 |
| | 146 | Wenning Clapham Station | SD 739678 | 13.00 | 36.0 | 468.0 |
| | 145 | Wenning Greystonegill Br. | SD 694682 | 6.00 | 60.0 | 360.0 |
| | 144 | Wenning High Bentham | SD 664688 | 10.00 | 22.0 | 220.0 |
| | 143 | Wenning Low Bentham | SD 646693 | 5.00 | 23.0 | 115.0 |
| | 142 | Wenning The Blands | SD 631700 | 15.00 | 30.0 | 450.0 |
| | 141 | Wenning Above Wennington | SD 621702 | 10.00 | 35.0 | 350.0 |
| | 140 | Wenning Wennington | SD 614702 | 13.00 | 35.0 | 455.0 |
| | 139 | Wenning Hornby | SD 582684 | 14.00 | 30.0 | 420.0 |
| 13 | 156 | Hindburn Top | SD 652639 | 4.50 | 28.0 | 126.0 |
| | 155 | Hindburn Furness Ford Br. | SD 635670 | 6.00 | 35.0 | 210.0 |
| | 154 | Hindburn Bottom | SD 611675 | 8.00 | 25.0 | 200.0 |

Appendix 1. (Cont.)

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 13 | 158 | Roeburn Top | SD 603638 | 4.00 | 30.0 | 120.0 |
| | 157 | Roeburn Wray | SD 604672 | 6.00 | 40.0 | 240.0 |

1983

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 1 | 21 | Lune Wath | NY 680052 | 4.00 | 40.0 | 160.0 |
| | 20 | Lune Kelleth Br. | NY 661051 | 7.00 | 30.0 | 210.0 |
| | 19 | Lune Rayne Br. | NY 644056 | 7.00 | 27.0 | 189.0 |
| | 18 | Lune u/s Tebay Br. | NY 622056 | 15.00 | 35.0 | 525.0 |
| | 17 | Lune Tebay | NY 613044 | 10.00 | 40.0 | 400.0 |
| | 101 | Weasdale | NY 690048 | 2.50 | 32.0 | 80.0 |
| | 102 | Bowderdale Bottom | NY 678050 | 5.00 | 30.0 | 150.0 |
| | 103 | Bowderdale Top | NY 676041 | 5.00 | 32.0 | 160.0 |
| | 104 | Longdale B. | NY 644047 | 4.00 | 35.0 | 140.0 |
| | 105 | Ellergill | NY 639049 | 2.50 | 44.0 | 110.0 |
| | 106 | Rais B. | NY 637065 | 4.00 | 53.0 | 212.0 |
| | 107 | Tebay Gill | NY 622034 | 2.50 | 35.0 | 87.5 |
| | 108 | Chapel B. Orton | NY 622062 | 7.00 | 51.0 | 357.0 |
| 2 | 16 | Lune Yorkshire Br. | NY 612008 | 21.00 | 25.0 | 525.0 |
| | 15 | Lune Fairmile | SD 625988 | 30.00 | 32.0 | 960.0 |
| | 14 | Lune Fleetholme | SD 625968 | 24.00 | 15.0 | 360.0 |
| | 13 | Lune Thwaites | SD 627948 | 16.00 | 35.0 | 560.0 |
| | 12 | Lune Lincolns Inn | SD 632924 | 19.00 | 27.0 | 513.0 |
| | 11A | Lune Park Wood | SD 628891 | 10.00 | 45.0 | 450.0 |
| 3 | 10 | Lune Hall B. | SD 625882 | 24.00 | 25.0 | 600.0 |
| | 9 | Lune Middleton Hall | SD 622867 | 25.00 | 35.0 | 875.0 |
| | 8 | Lune Rigmaden | SD 616847 | 19.00 | 30.0 | 570.0 |
| | 7 | Lune u/s Underley Br. | SD 608808 | 50.00 | 22.0 | 1100.0 |
| | 6 | Lune Kirkby Island | SD 617787 | 20.00 | 22.0 | 440.0 |
| 4 | 5 | Lune Whittington | SD 609753 | 25.00 | 20.0 | 500.0 |
| | 4 | Lune Newton | SD 601742 | 21.00 | 26.0 | 546.0 |
| | 3 | Lune Gresssingham | SD 578703 | 30.00 | 25.0 | 750.0 |
| | 2 | Lune Snab | SD 564676 | 25.00 | 30.0 | 750.0 |
| | 1 | Lune Caton | SD 540653 | 20.00 | 46.0 | 920.0 |
| 5 | 109 | Birk B. Greenholme | NY 600056 | 8.00 | 32.0 | 256.0 |
| | 110 | Birk B. Scout Green | NY 594075 | 9.00 | 31.0 | 279.0 |
| | 111 | Birk B. Shap Well | NY 582096 | 4.00 | 38.0 | 152.0 |
| | 112 | Bretherdale u/s Birk B. | NY 597051 | 5.50 | 40.0 | 220.5 |
| | 113 | Borrow B. Low Borrow Br. | NY 586012 | 9.00 | 33.0 | 297.0 |
| | 114 | Borrow B. Wood Br. | NY 575023 | 7.00 | 37.0 | 259.0 |
| 6 | 115 | Chapel B. Above Lune | SD 632948 | 6.00 | 44.0 | 264.0 |
| | 116 | Crossdale B. | SD 637936 | 3.00 | 34.0 | 102.0 |
| 7 | 120 | Rawthey Low Haygarth Fm. | NY 695968 | 11.00 | 30.0 | 330.0 |
| | 119 | Rawthey Burnt Mill | SD 692953 | 11.00 | 50.0 | 550.0 |
| | 119A | Rawthey Cautley | SD 959695 | 7.00 | 43.0 | 371.0 |

Appendix 1. (Cont.)

| Subcatchment | Site | Site Name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 7 | 118 | Rawthey Sedbergh | SD 663916 | 6.00 | 50.0 | 300.0 |
| | 117 | Rawthey Ingmire | SD 638911 | 22.00 | 40.0 | 880.0 |
| 8 | 123 | Clough Top | SD 730900 | 7.00 | 42.0 | 294.0 |
| | 122 | Clough New Br. | SD 717906 | 5.50 | 41.0 | 225.5 |
| | 121 | Clough Farfield Mill | SD 683917 | 10.00 | 34.0 | 340.0 |
| 9 | 127 | Dee Dent | SD 708872 | 11.00 | 44.0 | 484.0 |
| | 126 | Dee Bath Br. | SD 693879 | 17.00 | 40.0 | 680.0 |
| | 125 | Dee Wood Br. | SD 675889 | 9.00 | 49.0 | 441.0 |
| | 124 | Dee Rash Mill | SD 657902 | 15.00 | 36.0 | 540.0 |
| 10 | 130 | Barbon B. Top | SD 658832 | 7.00 | 38.0 | 266.0 |
| | 129 | Barbon B. Middle | SD 623824 | 8.00 | 42.0 | 336.0 |
| | 128 | Barbon B. Lower | SD 613818 | 9.00 | 47.0 | 423.0 |
| | 132 | Leck B. Top | SD 629764 | 7.00 | 36.0 | 252.0 |
| | 131 | Leck B. Leck B. Br. | SD 616757 | 7.00 | 35.0 | 245.0 |
| 11 | 138 | Kingsdale B. | SD 695760 | 7.00 | 38.0 | 266.0 |
| | 137 | Doe Dale House | SD 720758 | 8.00 | 40.0 | 320.0 |
| | 137A | Doe Le Dale | SD 733764 | 10.00 | 60.0 | 600.0 |
| | 136 | Greta Ingleton | SD 687727 | 10.00 | 34.0 | 340.0 |
| | 135 | Greta Falcon fm. | SD 668717 | 9.00 | 52.0 | 468.0 |
| | 134 | Greta Burton in Lonsdale | SD 655720 | 12.00 | 53.0 | 636.0 |
| | 133 | Greta Greta Br. | SD 609728 | 10.00 | 44.0 | 440.0 |
| 12 | 153 | Keasden B. | SD 717666 | 5.00 | 40.0 | 200.0 |
| | 151 | Austwick B. Harden Br. | SD 761678 | 7.00 | 30.0 | 210.0 |
| | 151B | Austwick B. Above Harden | | 8.00 | 44.0 | 352.0 |
| | 148 | Wenning Clapham B. | SD 744685 | 5.00 | 55.0 | 275.0 |
| | 146 | Wenning Clapham Station | SD 739678 | 13.00 | 47.0 | 611.0 |
| | 145 | Wenning Greystonegill Br. | SD 694682 | 7.00 | 39.0 | 273.0 |
| | 144 | Wenning High Bentham | SD 664688 | 9.00 | 38.0 | 342.0 |
| | 143 | Wenning Low Bentham | SD 646693 | 6.00 | 49.0 | 294.0 |
| | 142 | Wenning The Blands | SD 631700 | 16.00 | 32.0 | 512.0 |
| | 140 | Wenning Wennington | SD 614702 | 19.00 | 42.0 | 798.0 |
| | 139 | Wenning Hornby | SD 582684 | 15.00 | 48.0 | 720.0 |
| 13 | 156 | Hindburn Top | SD 652639 | 4.00 | 47.0 | 188.0 |
| | 155 | Hindburn Furness Ford Br. | SD 635670 | 8.00 | 45.0 | 360.0 |
| | 154 | Hindburn Bottom | SD 611675 | 10.00 | 40.0 | 400.0 |
| | 158 | Roeburn Top | SD 603638 | 5.00 | 34.0 | 170.0 |
| | 157 | Roeburn Wray | SD 604672 | 7.00 | 50.0 | 350.0 |

1984

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 1 | 21 | Lune Wath | NY 680052 | 2.50 | 30.0 | 75.0 |
| | 20 | Lune Kelleth Br. | NY 661051 | 7.00 | 30.0 | 210.0 |
| | 19 | Lune Rayne Br. | NY 644056 | 5.00 | 30.0 | 150.0 |
| | 18 | Lune u/s Tebay Br. | NY 622056 | 13.00 | 40.0 | 520.0 |
| | 17 | Lune Tebay | NY 613044 | 17.00 | 38.0 | 646.0 |

Appendix 1. (Cont.)

| Subcatchment | Site | Site Name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 1 | 101 | Weasdale | NY 690048 | 1.50 | 36.0 | 54.0 |
| | 102 | Bowderdale Bottom | NY 676041 | 3.00 | 25.0 | 75.0 |
| | 103 | Bowderdale Top | NY 678050 | 3.00 | 50.0 | 150.0 |
| | 104 | Longdale B. | NY 644047 | 4.00 | 18.0 | 72.0 |
| | 105 | Ellergill B. | NY 639049 | 2.20 | 35.0 | 77.0 |
| | 106 | Rais B. | NY 637065 | 3.00 | 32.0 | 96.0 |
| | 107 | Tebay Gill | NY 622034 | 1.70 | 28.0 | 47.6 |
| | 108 | Chapel B. Orton | NY 622062 | 4.00 | 35.0 | 140.0 |
| 2 | 16 | Lune Yorkshire Br. | NY 612008 | 15.00 | 33.0 | 495.0 |
| | 15 | Lune Fairmile | SD 625988 | 21.00 | 47.0 | 987.0 |
| | 14 | Lune Fleetholme | SD 625968 | 20.00 | 35.0 | 700.0 |
| | 13 | Lune Thwaites | SD 627947 | 17.00 | 33.0 | 561.0 |
| | 12 | Lune Lincolns Inn | SD 632924 | 21.00 | 33.0 | 693.0 |
| | 11A | Lune Park Wood | SD 623898 | 18.00 | 32.0 | 576.0 |
| 3 | 10 | Lune Hall B. | SD 625882 | 21.00 | 30.0 | 630.0 |
| | 9 | Lune Middleton Hall | SD 622867 | 25.00 | 60.0 | 1500.0 |
| | 8 | Lune Rigmaden | SD 616817 | 18.00 | 35.0 | 630.0 |
| | 7 | Lune u/s Underley Br. | SD 608808 | 32.00 | 46.0 | 1472.0 |
| | 6 | Lune Kirkby Island | SD 617787 | 24.00 | 40.0 | 960.0 |
| 4 | 5 | Lune Whittington | SD 609756 | 26.00 | 35.0 | 910.0 |
| | 4 | Lune Newton | SD 601742 | 19.00 | 45.0 | 855.0 |
| | 3 | Lune Gresssingham | SD 578903 | 33.00 | 63.0 | 2079.0 |
| | 2 | Lune Snab | SD 564676 | 25.00 | 48.0 | 1200.0 |
| | 1 | Lune Caton | SD 540653 | 22.00 | 50.0 | 1100.0 |
| 5 | 109 | Birk B. Greenholme | NY 600056 | 6.00 | 36.0 | 216.0 |
| | 110 | Birk B. Scout Green | NY 594075 | 8.00 | 30.0 | 240.0 |
| | 111 | Birk B. Shap Well | NY 582096 | 4.00 | 36.0 | 144.0 |
| | 112 | Bretherdale u/s Birk B. | NY 597051 | 6.00 | 39.0 | 234.0 |
| | 113 | Borrow B. Low Borrow Br.e | NY 586012 | 7.50 | 33.0 | 247.5 |
| | 114 | Borrow B. Wood Br. | NY 575023 | 8.00 | 30.0 | 240.0 |
| 6 | 115 | Chapel B. Above Lune | SD 632948 | 4.00 | 30.0 | 120.0 |
| | 116 | Crossdale B. | SD 637936 | 1.40 | 25.0 | 35.0 |
| 7 | 120 | Rawthey Low Haygarth Fm. | NY 695968 | 16.00 | 39.0 | 624.0 |
| | 119 | Rawthey Burnt Mill | SD 692953 | 9.00 | 35.0 | 315.0 |
| | 119A | Rawthey Cautley | SD 659695 | 8.00 | 30.0 | 240.0 |
| | 118 | Rawthey Sedbergh | SD 663916 | 10.00 | 30.0 | 300.0 |
| | 117 | Rawthey Ingmire | SD 638911 | 20.00 | 30.0 | 600.0 |
| 8 | 123 | Clough Top | SD 730900 | 5.00 | 44.0 | 220.0 |
| | 122 | Clough New Br. | SD 717906 | 3.00 | 24.0 | 72.0 |
| | 121 | Clough Farfield Mill | SD 683917 | 7.00 | 25.0 | 175.0 |
| 9 | 127 | Dee Dent | SD 708872 | 5.00 | 33.0 | 165.0 |
| | 126 | Dee Bath Br. | SD 675889 | 12.00 | 35.0 | 420.0 |
| | 125 | Dee Wood Br. | SD 693879 | 7.00 | 33.0 | 231.0 |
| | 124 | Dee Rash Mill | SD 657902 | 7.00 | 33.0 | 231.0 |
| 10 | 130 | Barbon B. Top | SD 658832 | 4.00 | 29.0 | 116.0 |

Appendix 1. (Cont.)

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 10 | 129 | Barbon B. Middle | SD 623824 | 7.00 | 30.0 | 210.0 |
| | 128 | Barbon B. Lower | SD 613818 | 4.00 | 25.0 | 100.0 |
| | 132 | Leck B. Top | SD 629764 | 6.00 | 31.0 | 186.0 |
| | 131 | Leck B. Leck B. Br. | SD 616757 | 4.00 | 30.0 | 120.0 |
| 11 | 138 | Kingsdale B. | SD 695760 | 7.00 | 50.0 | 350.0 |
| | 137 | Doe Dale House | SD 720758 | 8.00 | 55.0 | 440.0 |
| | 136 | Greta Ingleton | SD 687727 | 12.00 | 45.0 | 540.0 |
| | 135 | Greta Falcon Fm. | SD 668717 | 7.00 | 35.0 | 245.0 |
| | 134 | Greta Burton in Lonsdale | SD 655720 | 12.00 | 35.0 | 420.0 |
| | 133 | Greta Greta Br. | SD 609728 | 8.00 | 36.0 | 288.0 |
| 12 | 153 | Keasden B. | SD 717666 | 4.00 | 40.0 | 160.0 |
| | 152 | Fen B. u/s Waters Br. | SD 754668 | 3.00 | 36.0 | 108.0 |
| | 151 | Austwick B. Harden Br. | SD 761678 | 5.50 | 30.0 | 165.0 |
| | 151B | Austwick B. Above Harden | | 4.50 | 38.0 | 171.0 |
| | 148 | Wenning Clapham B. | SD 744685 | 5.00 | 43.0 | 215.0 |
| | 146 | Wenning Clapham Station | SD 739678 | 13.00 | 55.0 | 715.0 |
| | 145 | Wenning Greystonegill Br. | SD 694682 | 10.00 | 43.0 | 430.0 |
| | 144 | Wenning High Bentham | SD 664688 | 12.00 | 40.0 | 480.0 |
| | 143 | Wenning Low Bentham | SD 646693 | 6.00 | 40.0 | 240.0 |
| | 142 | Wenning The Blands | SD 631700 | 17.00 | 33.0 | 561.0 |
| | 140 | Wenning Wennington | SD 614702 | 17.00 | 40.0 | 680.0 |
| | 139 | Wenning Hornby | SD 582684 | 16.00 | 35.0 | 560.0 |
| 13 | 156 | Hindburn Top | SD 652639 | 3.00 | 40.0 | 120.0 |
| | 155 | Hindburn Furness Ford Br. | SD 635670 | 10.00 | 50.0 | 500.0 |
| | 154 | Hindburn Bottom | SD 611675 | 8.00 | 36.0 | 288.0 |
| | 158 | Roeburn Top | SD 603638 | 5.00 | 32.0 | 160.0 |
| | 157 | Roeburn Wray | SD 604672 | 11.00 | 33.0 | 363.0 |

1985

| Subcatchment | Site | Site name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 1 | 21 | Lune Wath | NY 680052 | 6.00 | 38.0 | 228.0 |
| | 20 | Lune Kelleth Br. | NY 661051 | 7.50 | 35.0 | 262.5 |
| | 19 | Lune Rayne Br. | NY 644056 | 10.00 | 38.0 | 380.0 |
| | 18 | Lune u/s Tebay Br. | NY 622056 | 15.00 | 40.0 | 600.0 |
| | 17 | Lune Tebay | NY 613044 | 20.00 | 38.0 | 760.0 |
| | 101 | Weasdale | NY 690048 | 2.00 | 45.0 | 90.0 |
| | 102 | Bowderdale Bottom | NY 678050 | 4.00 | 42.0 | 168.0 |
| | 103 | Bowderdale Top | NY 676041 | 3.50 | 39.0 | 136.5 |
| | 104 | Longdale B. | NY 644047 | 8.00 | 40.0 | 320.0 |
| | 106 | Rais B. | NY 637065 | 3.00 | 27.0 | 81.0 |
| | 107 | Tebay Gill | NY 622034 | 2.00 | 28.0 | 56.5 |
| | 108 | Chapel B. Orton | NY 622062 | 5.50 | 26.0 | 143.0 |
| 2 | 16 | Lune Yorkshire Br. | NY 612008 | 17.00 | 42.0 | 714.0 |
| | 15 | Lune Fairmile | SD 625988 | 25.00 | 42.0 | 1050.0 |
| | 14 | Lune Fleetholme | SD 625968 | 22.00 | 50.0 | 1100.0 |
| | 13 | Lune Thwaites | SD 627948 | 24.00 | 32.0 | 768.0 |
| | 12 | Lune Lincolns Inn | SD 632924 | 28.00 | 25.0 | 700.0 |

Appendix 1. (Cont.)

| Subcatchment | Site | Site Name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 2 | 11A | Lune Park Wood | SD 628891 | 52.00 | 22.0 | 1144.0 |
| 3 | 10 | Lune Hall B. | SD 625882 | 38.00 | 35.0 | 1330.0 |
| | 9 | Lune Middleton Hall | SD 622867 | 28.00 | 50.0 | 1400.0 |
| | 8 | Lune Rigmaden | SD 616847 | 23.00 | 33.0 | 759.0 |
| | 7 | Lune u/s Underley Br. | SD 608808 | 40.00 | 25.0 | 1000.0 |
| | 6 | Lune Kirkby Island | SD 617787 | 28.00 | 32.0 | 896.0 |
| 4 | 5 | Lune Whittington | SD 609753 | 33.00 | 38.0 | 1254.0 |
| | 4 | Lune Newton | SD 601742 | 56.00 | 22.0 | 1232.0 |
| | 3 | Lune Gresssingham | SD 578703 | 21.00 | 52.0 | 1092.0 |
| | 2 | Lune Snab | SD 564676 | 27.00 | 52.0 | 1404.0 |
| | 1 | Lune Caton | SD 540653 | 30.00 | 50.0 | 1500.0 |
| 5 | 109 | Birk B. Greenholme | NY 600056 | 9.00 | 32.0 | 288.0 |
| | 110 | Birk B. Scout Green | NY 594075 | 12.00 | 34.0 | 408.0 |
| | 111 | Birk B. Shap Well | NY 582096 | 6.00 | 40.0 | 240.0 |
| | 112 | Bretherdale u/s Birk B. | NY 597051 | 7.00 | 42.0 | 294.0 |
| | 113 | Borrow B. Low Borrow Br. | NY 586012 | 9.00 | 33.0 | 297.0 |
| | 114 | Borrow B. Wood Br. | NY 575023 | 10.00 | 46.0 | 460.0 |
| 6 | 115 | Chapel B. Above Lune | SD 632948 | 5.00 | 22.0 | 110.0 |
| | 116 | Crossdale B. | SD 637936 | 2.50 | 30.0 | 75.0 |
| 7 | 120 | Rawthey Low Haygarth Fm. | NY 695968 | 13.00 | 28.0 | 364.0 |
| | 119 | Rawthey Burnt Mill | SD 692953 | 17.00 | 23.0 | 391.0 |
| | 119A | Rawthey Cautley | SD 959695 | 13.00 | 34.0 | 442.0 |
| | 118 | Rawthey Sedbergh | SD 663916 | 20.00 | 36.0 | 720.0 |
| | 117 | Rawthey Ingmire | SD 638911 | 27.00 | 30.0 | 810.0 |
| 8 | 123 | Clough Top | SD 730900 | 8.00 | 45.0 | 360.0 |
| | 122 | Clough New Br. | SD 717906 | 9.00 | 40.0 | 360.0 |
| | 121 | Clough Farfield Mill | SD 683917 | 14.00 | 43.0 | 602.0 |
| 9 | 127 | Dee Dent | SD 708872 | 15.00 | 40.0 | 600.0 |
| | 126 | Dee Bath Br. | SD 693879 | 19.00 | 44.0 | 836.0 |
| | 125 | Dee Wood Br. | SD 675889 | 7.00 | 32.0 | 224.0 |
| | 124 | Dee Rash Mill | SD 657902 | 13.00 | 41.0 | 533.0 |
| 10 | 130 | Barbon B. Top | SD 658832 | 8.50 | 45.0 | 382.5 |
| | 129 | Barbon B. Middle | SD 623824 | 9.00 | 43.0 | 387.0 |
| | 128 | Barbon B. Lower | SD 613818 | 5.50 | 45.0 | 247.5 |
| | 132 | Leck B. Top | SD 629764 | 5.50 | 42.0 | 231.0 |
| | 131 | Leck B. Leck B. Br. | SD 616757 | 10.00 | 45.0 | 450.0 |
| 11 | 138 | Kingsdale B. | SD 695760 | 7.00 | 43.0 | 301.0 |
| | 137 | Doe Dale House | SD 720758 | 8.00 | 47.0 | 376.0 |
| | 136 | Greta Ingleton | SD 687727 | 17.00 | 40.0 | 680.0 |
| | 135 | Greta Falcon Fm. | SD 668717 | 7.00 | 50.0 | 350.0 |
| | 134 | Greta Burton in Lonsdale | SD 655720 | 13.00 | 45.0 | 585.0 |
| | 133 | Greta Greta Br. | SD 609728 | 10.00 | 45.0 | 450.0 |
| 12 | 153 | Keasden B. | SD 717666 | 5.00 | 50.0 | 250.0 |
| | 152 | Fen B. u/s Waters Br. | SD 753668 | 2.00 | 28.0 | 56.0 |

Appendix 1. (Cont.)

| Subcatchment | Site | Site Name | Grid Ref. | Width(m) | Length(m) | Area(m2) |
|---|---|---|---|---|---|---|
| 12 | 151 | Austwick B. Harden Br. | SD 761678 | 5.50 | 45.0 | 247.5 |
| | 151B | Austwick B. Above Harden | | 4.50 | 38.0 | 171.0 |
| | 148 | Wenning Clapham B. | SD 744685 | 7.00 | 55.0 | 385.0 |
| | 146 | Wenning Clapham Station | SD 739678 | 13.00 | 18.0 | 234.0 |
| | 145 | Wenning Greystonegill Br. | SD 694682 | 9.00 | 27.0 | 243.0 |
| | 144 | Wenning High Bentham | SD 664688 | 15.00 | 33.0 | 495.0 |
| | 143 | Wenning Low Bentham | SD 646693 | 10.00 | 36.0 | 360.0 |
| | 142 | Wenning The Blands | SD 631700 | 20.00 | 23.0 | 460.0 |
| | 140 | Wenning Wennington | SD 614702 | 21.00 | 27.0 | 567.0 |
| | 139 | Wenning Hornby | SD 582684 | 16.00 | 38.0 | 608.0 |
| 13 | 156 | Hindburn Top | SD 652639 | 5.00 | 43.0 | 215.0 |
| | 155 | Hindburn Furness Ford Br. | SD 635670 | 10.00 | 56.0 | 560.0 |
| | 154 | Hindburn Bottom | SD 611675 | 12.00 | 50.0 | 600.0 |
| | 158 | Roeburn Top | SD 603638 | 6.00 | 35.0 | 210.0 |
| | 157 | Roeburn Wray | SD 604672 | 14.00 | 50.0 | 700.0 |
| | 159 | Kettles B. u/s Waters Br. | SD 749661 | 2.00 | 32.0 | 64.0 |

Appendix 2 RIVER LUNE CATCHMENT ELECTROFISHING SURVEY 1981-85
0+ SALMON N/100m2 (95% CL)

| Site | Name | 1981 | 1982 | 1983 | 1984 | 1985 | MEAN |
|---|---|---|---|---|---|---|---|
| 17 | TEBAY | | 67.7 (9.8) | 48.3 (6.5) | 26.7 (4.3) | 32.7 (10.6) | 42.7 (98.8) |
| 18 | OLD TEBAY BR | 22.2 (MIN) | 60.0 (4.6) | 77.7 (7.2) | 18.4 (5.2) | 57.9 (MIN) | 52.2 (77.4) |
| 19 | RAYNE BR | 49.7 (12.4) | 51.3 (17.7) | 59.8 (13.7) | 13.1 (20.1) | 78.9 (48.2) | 55.8 (203.4) |
| 20 | KELLETH BR | 3.0 (MIN) | 61.8 (3.6) | 58.8 (0.0) | 35.8 (5.9) | 27.9 (7.2) | 43.8 (41.2) |
| 21 | WATH | 64.7 (3.9) | 70.3 (11.2) | 31.9 (19.0) | 19.7 (4.7) | 18.9 (3.1) | 41.7 (59.3) |
| 101 | WEASDALE B. | | 43.9 (20.9) | 5.0 (0.0) | 1.9 (0.0) | 1.1 (0.0) | 10.7 (43.3) |
| 102 | BOWDERDALE | | 22.7 (6.4) | 19.6 (17.5) | 33.9 (5.9) | 36.5 (MIN) | 23.6 (34.3) |
| 103 | BOWDERDALE | 0.0 (0.0) | 33.9 (7.4) | 143.4 (34.9) | 2.0 (3.9) | 152.6 (61.5) | 61.4 (139.1) |
| 104 | LONGDALE B. | 0.0 (0.0) | 6.4 (4.1) | 10.7 (MIN) | 1.4 (0.0) | 2.5 (MIN) | 2.7 (12.2) |
| 105 | ELLERGILL B. | | 1.5 (MIN) | 0.0 (0.0) | 3.9 (7.6) | 0.0 (0.0) | 1.6 (8.2) |
| 106 | RAIS B. | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 2.1 (0.0) | 0.0 (0.0) | 0.2 (1.9) |
| 107 | TEBAY GILL | | 43.7 (4.1) | 505.6 (60.3) | 113.1 (20.1) | 32.1 (MIN) | 246.9 (505.3) |
| 108 | CHAPEL B. | | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 2.1 (0.0) | 0.4 (2.1) |
| 11 | 4 LANE ENDS | | 6.3 (2.2) | | | | 6.3 (2.2) |
| 11A | PARK WOOD | | | 69.1 (13.8) | 31.6 (14.0) | 24.5 (2.6) | 22.9 (123.2) |
| 12 | LINCOLN INN | 1.2 (MIN) | 17.4 (7.1) | 12.8 (3.9) | 0.7 (MIN) | 1.7 (MIN) | 14.6 (26.1) |
| 13 | THWAITES | | 10.7 (2.3) | 33.4 (7.9) | 11.6 (1.8) | 6.1 (3.4) | 14.9 (59.4) |
| 14 | FLEETHOLM | 2.1 (MIN) | 2.8 (2.2) | 1.4 (0.3) | 0.0 (0.0) | 0.0 (0.0) | 1.0 (22.3) |
| 15 | FAIRMILE | 0.5 (0.0) | 7.9 (MIN) | 0.0 (0.0) | 1.7 (MIN) | 5.1 (MIN) | 0.3 (1.4) |
| 16 | YORKSHIRE BR | | 19.3 (1.7) | 3.2 (0.1) | 0.2 (MIN) | 0.6 (MIN) | 11.8 (23.3) |
| 6 | KIRBY LOND. | 8.2 (1.3) | 106.4 (7.1) | 29.1 (5.2) | 7.6 (0.7) | 4.6 (1.4) | 16.9 (96.4) |
| 7 | LINDERLAY | 3.6 (0.3) | 34.2 (9.7) | 21.8 (5.8) | 15.9 (2.0) | 63.9 (17.8) | 20.6 (218.1) |
| 8 | RIGMADEN | | 9.6 (2.7) | 6.9 (1.6) | 1.8 (1.8) | 2.6 (1.3) | 5.1 (26.7) |
| 9 | MIDDLETON | 1.0 (0.6) | 17.2 (3.2) | 7.9 (2.2) | 5.7 (3.6) | 19.2 (11.0) | 7.3 (170.5) |
| 10 | HALLBECK | 2.5 (0.2) | 10.9 (1.1) | 19.4 (4.8) | 13.2 (5.6) | 6.2 (1.1) | 8.3 (52.7) |
| 1 | CATON | 2.4 (0.3) | 20.1 (9.8) | 33.4 (6.2) | 9.4 (8.6) | 5.6 (MIN) | 11.2 (128.4) |
| 2 | SNAB | 0.4 (0.1) | 8.4 (2.5) | 2.1 (1.1) | 1.9 (MIN) | 4.2 (1.0) | 3.7 (31.1) |
| 3 | GRESSINGHAM | 2.8 (MIN) | 5.9 (0.5) | 57.1 (8.1) | 10.0 (3.1) | 20.5 (5.7) | 17.6 (120.5) |
| 4 | NEWTON | 4.5 (MIN) | 46.6 (7.0) | 62.2 (8.4) | 4.2 (0.3) | 27.1 (6.6) | 30.3 (114.8) |
| 5 | WHITTINGTON | 8.4 (6.0) | 28.2 (6.2) | 12.7 (7.2) | 12.7 (8.9) | 39.9 (19.1) | 21.3 (262.5) |
| 109 | BIRK B. | 0.0 (0.0) | 13.2 (2.5) | 46.1 (4.4) | 6.9 (8.9) | 107.5 (44.7) | 32.7 (160.5) |
| 110 | BIRK B. | 12.3 (3.3) | 8.7 (4.3) | 0.7 (0.0) | 9.6 (8.7) | 12.1 (2.3) | 9.5 (23.3) |
| 111 | BIRK B. | 0.0 (0.0) | 6.9 (4.6) | 15.1 (13.7) | 0.0 (0.0) | 16.7 (MIN) | 6.8 (26.4) |
| 112 | BRETHERDALE | | 51.7 (19.5) | 26.0 (4.9) | 7.8 (2.2) | 30.9 (12.5) | 29.9 (71.5) |
| 113 | BORROW B. | 0.0 (0.0) | 120.5 (12.1) | 21.4 (1.3) | 23.5 (2.5) | 21.2 (21.2) | 38.0 (143.8) |
| 114 | BORROW B. | | 74.9 (9.5) | 30.7 (6.4) | 9.6 (MIN) | 6.1 (0.6) | 26.9 (76.3) |
| 115 | CHAPEL B. | | 11.3 (5.3) | 81.5 (20.4) | 94.5 (20.9) | 39.3 (4.5) | 66.8 (100.7) |
| 116 | CROSDALE B. | | 251.3 (123.7) | 14.7 (MIN) | 2.9 (10.9) | 0.0 (0.0) | 54.6 (300.3) |
| 117 | INGMIRE | 0.8 (MIN) | 28.8 (6.7) | 49.6 (4.5) | 10.7 (3.2) | 19.4 (MIN) | 32.5 (51.8) |
| 118 | SEDBERGH | 2.2 (0.4) | 33.0 (12.8) | 104.4 (16.1) | 55.7 (15.1) | 29.6 (5.5) | 39.9 (122.0) |
| 119 | BURNT MILL | 0.0 (0.0) | 9.8 (3.0) | 30.7 (2.8) | 14.3 (MIN) | 21.9 (MIN) | 15.5 (36.7) |
| 119A | CAUTLEY | | | 27.3 (6.3) | 35.6 (8.6) | 22.5 (9.1) | 27.2 (51.7) |
| 120 | RAWTHEY | 0.0 (0.0) | 8.8 (5.6) | 0.6 (MIN) | 21.8 (5.3) | 5.2 (5.5) | 10.7 (56.4) |
| 121 | CLOUGH | 0.0 (0.0) | 0.0 (0.0) | 17.5 (6.5) | 19.1 (3.6) | 11.2 (6.0) | 7.5 (47.6) |
| 122 | CLOUGH | 0.0 (0.0) | 1.4 (2.8) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.2 (6.1) |
| 123 | CLOUGH | 0.0 (0.0) | 32.3 (5.4) | 0.0 (0.0) | 0.5 (0.0) | 0.0 (0.0) | 2.9 (30.6) |
| 124 | DEE | 4.4 (0.9) | 31.8 (3.1) | 10.5 (3.2) | 15.2 (7.6) | 9.9 (3.0) | 14.7 (36.9) |
| 125 | DEE | 29.2 (3.7) | 42.8 (9.8) | 39.5 (5.3) | 87.6 (10.1) | 68.0 (24.6) | 51.0 (85.7) |
| 126 | DEE | 1.4 (1.8) | 139.6 (8.5) | 4.6 (4.1) | 0.0 (0.0) | 3.2 (MIN) | 19.7 (146.2) |
| 127 | DEE | 0.0 (0.0) | 8.2 (1.0) | 0.8 (MIN) | 4.2 (14.1) | 0.0 (0.0) | 2.8 (25.1) |
| 128 | BARBON B. | 15.0 (1.1) | 223.2 (14.5) | 69.7 (14.0) | 279.9 (32.4) | 152.9 (25.2) | 98.1 (261.4) |
| 129 | BARBON B. | 22.4 (0.8) | 104.3 (10.2) | 60.5 (21.6) | 103.5 (18.3) | 91.5 (24.5) | 66.7 (149.3) |
| 130 | BARBON B. | 0.4 (MIN) | 5.5 (MIN) | 55.1 (23.9) | 0.0 (0.0) | 3.4 (0.2) | 20.9 (86.4) |
| 131 | LECK BECK | 2.9 (0.4) | 6.8 (MIN) | 59.7 (11.5) | 41.5 (7.7) | 21.3 (MIN) | 23.4 (60.6) |
| 132 | LECK BECK | 0.0 (0.0) | 7.2 (2.7) | 39.5 (11.6) | 17.5 (1.2) | 3.0 (3.9) | 14.5 (45.0) |
| 133 | GRETA | 1.8 (0.9) | 38.3 (7.3) | 47.2 (5.3) | 45.2 (21.0) | 21.7 (4.9) | 16.2 (89.4) |
| 134 | GRETA | 4.3 (0.9) | 17.5 (1.2) | 23.6 (12.0) | 18.4 (7.6) | 6.2 (0.0) | 13.9 (80.1) |
| 135 | GRETA | 2.5 (0.9) | 19.7 (8.2) | 43.8 (5.3) | 23.1 (6.9) | 21.7 (11.6) | 21.6 (65.4) |
| 136 | GRETA | | 21.3 (2.9) | 15.3 (18.6) | 0.2 (MIN) | 9.6 (2.7) | 13.3 (68.4) |
| 137 | DOE | | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 137A | DOE | | | 0.0 (0.0) | | | 0.0 (0.0) |
| 138 | GRETA | | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 139 | WENNING | 2.5 (0.2) | 42.6 (7.9) | 7.7 (2.7) | 3.9 (MIN) | 3.9 (MIN) | 12.3 (50.4) |
| 140 | WENNING | 0.0 (0.0) | 14.2 (4.2) | 0.0 (0.0) | 0.2 (0.0) | 0.0 (0.0) | 1.7 (23.4) |
| 141 | WENNING | | 4.3 (3.8) | | | | 4.3 (3.8) |
| 142 | WENNING | | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 143 | WENNING | | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 144 | WENNING | | 1.4 (2.7) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.2 (6.2) |
| 145 | WENNING | 0.2 (MIN) | 10.6 (2.7) | 3.7 (MIN) | 5.8 (10.2) | 1.7 (1.1) | 7.7 (46.1) |
| 146 | WENNING | 3.3 (0.2) | 29.5 (2.9) | 15.0 (4.3) | 9.4 (3.4) | 133.6 (31.5) | 24.6 (140.8) |
| 147 | WENNING | | 9.8 (MIN) | | | | 0.0 (0.0) |
| 148 | CLAPHAM B. | 1.0 (MIN) | 1.1 (MIN) | 0.7 (MIN) | 1.4 (2.7) | 0.0 (0.0) | 0.5 (6.1) |
| 149 | AUSTWICK B. | | 12.2 (MIN) | | | | 0.0 (0.0) |
| 150 | AUSTWICK B. | | 1.5 (MIN) | | | 13.9 (6.6) | 13.9 (6.6) |
| 151 | AUSTWICK B. | | 5.6 (7.1) | 7.6 (16.7) | 0.0 (0.0) | 27.8 (7.6) | 12.3 (48.5) |
| 151B | AUSTWICK B. | | | 0.3 (0.0) | | | 0.3 (0.0) |
| 152 | FEN B. | | 4.9 (16.1) | | 0.0 (0.0) | 0.0 (0.0) | 2.3 (24.4) |
| 153 | KEASDEN B. | | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 154 | HINDBURN | 0.0 (0.0) | 27.6 (11.5) | 0.0 (0.0) | 0.0 (0.0) | 0.2 (0.0) | 2.8 (34.6) |
| 155 | HINDBURN | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 156 | HINDBURN | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 157 | ROEBURN | 0.3 (0.0) | 27.7 (3.8) | 1.1 (0.8) | 0.0 (0.0) | 2.6 (MIN) | 5.3 (29.3) |
| 158 | ROEBURN | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |

A 86+
B 45-86
C 23-45
D 9-23
E 0-9
F 0

## Appendix 3 RIVER LUNE CATCHMENT ELECTROFISHING SURVEY 1981-85
### 1+ SALMON N/100m2 (95% CL)

| Site | Name | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | | MEAN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | TEBAY | | | 0.8 | (MIN) | 2.4 | (0.8) | 2.9 | (3.1) | 0.1 | (0.0) | 1.6 | (20.8) |
| 18 | OLD TEBAY BR | 3.1 | (0.5) | 3.1 | (0.9) | 4.0 | (0.3) | 8.4 | (6.6) | 6.6 | (0.6) | 4.9 | (35.9) |
| 19 | RAYNE BR | 14.4 | (0.9) | 7.5 | (3.7) | 6.1 | (4.2) | 27.6 | (3.7) | 1.8 | (0.4) | 9.7 | (25.0) |
| 20 | KELLETH BR | 3.8 | (MIN) | 10.3 | (1.1) | 19.8 | (3.7) | 14.3 | (2.3) | 3.1 | (MIN) | 15.3 | (13.5) |
| 21 | WATH | 9.3 | (0.9) | 17.4 | (5.3) | 3.8 | (0.0) | 5.3 | (0.0) | 0.9 | (0.0) | 6.4 | (13.5) |
| 101 | WEASDALE B. | | | 22.6 | (11.2) | 15.0 | (1.1) | 7.4 | (4.9) | 1.1 | (0.0) | 10.5 | (19.9) |
| 102 | BOWDERDALE | | | 7.7 | (5.3) | 12.0 | (2.8) | 28.3 | (9.7) | 10.8 | (2.6) | 12.8 | (22.7) |
| 103 | BOWDERDALE | 25.1 | (5.2) | 1.1 | (0.0) | 4.7 | (15.5) | 7.5 | (0.0) | 2.9 | (0.6) | 9.4 | (31.1) |
| 104 | LONGDALE B. | 14.2 | (0.7) | 7.9 | (6.2) | 29.9 | (MIN) | 61.6 | (2.3) | 3.8 | (1.9) | 12.7 | (60.0) |
| 105 | ELLERGILL B. | | | 5.6 | (4.1) | 44.6 | (8.8) | 5.2 | (0.0) | | | 18.8 | (46.7) |
| 106 | RAIS B. | 7.4 | (0.5) | 2.2 | (4.3) | 0.0 | (0.0) | 0.0 | (0.0) | 12.4 | (0.0) | 5.1 | (12.7) |
| 107 | TEBAY GILL | | | 7.5 | (0.3) | 70.2 | (12.9) | 61.6 | (5.4) | 8.9 | (MIN) | 44.5 | (69.2) |
| 108 | CHAPEL B. | | | 8.3 | (5.7) | 6.6 | (1.5) | 2.1 | (0.0) | 1.4 | (0.0) | 5.2 | (11.9) |
| 11 | 4 LANE ENDS | | | 0.3 | (0.0) | | | | | | | 0.3 | (0.0) |
| 11A | PARK WOOD | | | | | 0.2 | (0.0) | 4.3 | (1.5) | 0.4 | (0.1) | 1.4 | (10.1) |
| 12 | LINCOLN INN | 6.2 | (0.9) | 4.3 | (1.0) | 4.7 | (0.5) | 20.3 | (3.3) | 1.2 | (0.6) | 7.7 | (17.9) |
| 13 | THWAITES | | | 4.3 | (0.3) | 2.8 | (1.8) | 15.4 | (1.8) | 5.1 | (2.2) | 6.9 | (25.3) |
| 14 | FLEETHOLME | 2.9 | (0.5) | 0.1 | (0.0) | 1.4 | (0.3) | 6.3 | (0.7) | 0.6 | (MIN) | 2.6 | (7.8) |
| 15 | FAIRMILE | 2.2 | (0.3) | 1.3 | (0.6) | 2.9 | (1.3) | 5.0 | (0.5) | 2.7 | (1.1) | 2.9 | (18.9) |
| 16 | YORKSHIRE BR | | | 1.2 | (0.3) | 2.7 | (0.4) | 27.4 | (6.6) | 14.2 | (23.7) | 11.1 | (174.3) |
| 6 | KIRBY LOND. | 4.8 | (0.7) | 0.0 | (0.0) | 3.4 | (4.4) | 5.2 | (1.1) | 0.8 | (2.6) | 3.6 | (31.9) |
| 7 | LINDERLAY | 1.2 | (0.1) | 0.4 | (0.7) | 0.0 | (0.0) | 0.5 | (0.6) | 0.3 | (0.6) | 0.7 | (12.8) |
| 8 | RIGMADEN | | | 0.6 | (0.4) | 0.0 | (0.0) | 5.7 | (5.6) | 0.9 | (3.1) | 1.8 | (43.5) |
| 9 | MIDDLETON | 1.1 | (0.2) | 2.5 | (1.6) | 1.3 | (1.3) | 2.6 | (1.4) | 1.7 | (0.4) | 1.6 | (27.3) |
| 10 | HALLBECK | 1.8 | (0.1) | 0.9 | (0.0) | 1.4 | (0.7) | 11.9 | (9.1) | 1.9 | (0.5) | 2.7 | (60.9) |
| 1 | CATON | 0.04 | (MIN) | 0.0 | (0.0) | 0.1 | (0.0) | 1.0 | (1.8) | 0.1 | (0.0) | 0.3 | (19.9) |
| 2 | SNAB | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.6 | (1.9) | 0.1 | (MIN) | 0.2 | (23.7) |
| 3 | GRESSINGHAM | 0.1 | (MIN) | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (MIN) | 0.0 | (0.0) | 0.0 | (0.0) |
| 4 | NEWTON | 1.9 | (0.6) | 1.3 | (1.7) | 0.6 | (1.1) | 6.6 | (1.4) | 0.6 | (0.5) | 2.2 | (14.7) |
| 5 | WHITTINGTON | 0.6 | (0.1) | 0.6 | (0.4) | 0.4 | (MIN) | 0.8 | (0.9) | 0.2 | (0.5) | 0.5 | (11.7) |
| 109 | BIRK B. | 9.6 | (0.6) | 1.7 | (0.4) | 7.6 | (4.6) | 8.6 | (1.6) | 3.8 | (6.8) | 5.9 | (24.6) |
| 110 | BIRK B. | 6.3 | (0.2) | 7.3 | (2.2) | 11.7 | (1.5) | 10.7 | (3.3) | 4.9 | (0.8) | 7.5 | (14.6) |
| 111 | BIRK B. | | | 3.7 | (0.1) | 31.4 | (22.7) | 33.2 | (4.1) | 2.9 | (0.0) | 13.6 | (49.9) |
| 112 | BRETHERDALE | | | 10.9 | (6.7) | 13.8 | (0.7) | 2.1 | (0.4) | 5.4 | (2.7) | 7.6 | (18.0) |
| 113 | BORROW B. | 11.9 | (1.6) | 10.7 | (0.7) | 14.9 | (1.6) | 11.0 | (0.7) | 12.9 | (3.6) | 12.5 | (18.7) |
| 114 | BORROW B. | | | 11.5 | (1.2) | 24.2 | (2.6) | 17.9 | (4.3) | 17.1 | (6.2) | 18.0 | (18.1) |
| 115 | CHAPEL B. | | | 2.7 | (MIN) | 2.7 | (3.4) | 23.5 | (2.3) | 39.9 | (14.9) | 16.0 | (44.5) |
| 116 | CROSDALE B. | | | 13.3 | (8.9) | 16.4 | (6.5) | 50.1 | (22.2) | 9.5 | (1.1) | 18.8 | (39.9) |
| 117 | INGMIRE | 6.5 | (1.4) | 1.6 | (0.7) | 2.2 | (1.7) | 7.9 | (0.9) | 3.6 | (1.2) | 4.5 | (21.1) |
| 118 | SEDBERGH | 33.8 | (1.7) | 10.6 | (2.8) | 30.7 | (5.9) | 42.6 | (3.9) | 9.5 | (2.8) | 21.8 | (44.2) |
| 119 | BURNT MILL | 4.9 | (3.2) | 2.8 | (1.3) | 3.3 | (0.1) | 16.7 | (5.1) | 8.0 | (7.2) | 6.6 | (35.5) |
| 119A | CAUTLEY | | | | | 2.3 | (7.7) | 5.4 | (2.1) | 3.6 | (1.8) | 3.7 | (25.7) |
| 120 | RAWTHEY | 11.3 | (1.1) | 0.8 | (0.0) | 2.6 | (1.2) | 2.6 | (1.3) | 3.6 | (0.7) | 3.6 | (12.9) |
| 121 | CLOUGH | 5.3 | (0.4) | 0.2 | (MIN) | 0.6 | (MIN) | 4.9 | (2.3) | 3.5 | (1.2) | 6.1 | (9.8) |
| 122 | CLOUGH | 0.0 | (0.0) | 0.0 | (0.0) | 3.1 | (3.9) | 0.0 | (0.0) | 0.6 | (MIN) | 0.7 | (9.7) |
| 123 | CLOUGH | 0.0 | (0.0) | 0.0 | (0.0) | 3.8 | (0.0) | 0.9 | (0.0) | 1.1 | (MIN) | 1.3 | (3.6) |
| 124 | DEE | 9.5 | (0.8) | 2.9 | (0.1) | 8.7 | (1.1) | 17.9 | (2.4) | 2.8 | (2.5) | 7.0 | (20.5) |
| 125 | DEE | 4.5 | (0.5) | 6.4 | (2.1) | 1.1 | (0.2) | 3.3 | (2.4) | 0.0 | (0.0) | 2.9 | (9.8) |
| 126 | DEE | 5.9 | (1.8) | 8.4 | (6.9) | 4.3 | (1.3) | 2.0 | (0.9) | 1.8 | (1.2) | 3.8 | (18.9) |
| 127 | DEE | 10.9 | (1.2) | 3.9 | (0.2) | 8.9 | (6.0) | 5.2 | (2.4) | 1.3 | (0.2) | 5.8 | (31.3) |
| 128 | BARBON B. | 5.5 | (0.4) | 13.3 | (MIN) | 5.4 | (4.9) | 9.4 | (3.0) | 6.1 | (5.3) | 5.9 | (25.7) |
| 129 | BARBON B. | 8.5 | (0.3) | 5.5 | (1.4) | 9.2 | (5.6) | 23.3 | (4.6) | 2.2 | (1.0) | 8.7 | (27.7) |
| 130 | BARBON B. | 21.3 | (1.8) | 33.9 | (5.2) | 14.9 | (13.1) | 38.4 | (7.9) | 15.9 | (3.1) | 19.8 | (46.3) |
| 131 | LECK BECK | 12.2 | (0.4) | 4.7 | (0.6) | 4.7 | (3.2) | 43.3 | (9.3) | 9.1 | (9.7) | 11.1 | (57.5) |
| 132 | LECK BECK. | 17.1 | (1.2) | 15.4 | (7.1) | 4.1 | (0.9) | 11.8 | (3.5) | 13.1 | (3.6) | 11.9 | (19.9) |
| 133 | GRETA | 0.9 | (0.4) | 1.3 | (0.0) | 3.2 | (MIN) | 16.3 | (8.1) | 3.7 | (1.5) | 4.3 | (28.9) |
| 134 | GRETA | 2.2 | (0.4) | 0.5 | (MIN) | 3.0 | (1.8) | 13.3 | (3.7) | 0.0 | (0.0) | 1.9 | (18.2) |
| 135 | GRETA | 19.8 | (1.5) | 3.2 | (0.4) | 0.9 | (0.6) | 28.9 | (4.9) | 6.8 | (3.2) | 11.2 | (29.8) |
| 136 | GRETA | | | 9.7 | (0.5) | 17.1 | (4.2) | 16.7 | (1.7) | 1.8 | (0.5) | 10.2 | (21.4) |
| 137 | DOE | | | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 137A | DOE | | | | | 0.0 | (0.0) | | | | | 0.0 | (0.0) |
| 138 | GRETA | | | 0.0 | (0.0) | 0.8 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.9) |
| 139 | WENNING | 1.0 | (0.3) | 9.7 | (1.7) | 2.1 | (1.4) | 11.3 | (6.4) | 2.9 | (0.9) | 4.5 | (39.8) |
| 140 | WENNING | 0.0 | (0.0) | 0.0 | (0.0) | 0.9 | (1.1) | 0.3 | (MIN) | 0.0 | (0.0) | 0.2 | (9.2) |
| 141 | WENNING | | | 0.0 | (0.0) | | | | | | | 0.0 | (0.0) |
| 142 | WENNING | | | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.0) | 0.0 | (0.0) | 0.1 | (0.2) |
| 143 | WENNING | | | 0.0 | (0.0) | 1.0 | (2.0) | 0.4 | (0.0) | 0.0 | (0.0) | 0.4 | (6.1) |
| 144 | WENNING | | | 1.4 | (2.7) | 7.2 | (1.4) | 0.8 | (0.6) | 0.0 | (0.0) | 2.1 | (10.5) |
| 145 | WENNING | 0.3 | (MIN) | 2.2 | (0.1) | 5.1 | (0.3) | 1.9 | (0.9) | 1.2 | (2.4) | 2.6 | (8.1) |
| 146 | WENNING | 0.8 | (0.1) | 0.1 | (0.0) | 2.6 | (1.3) | 0.4 | (0.8) | 0.4 | (0.0) | 0.9 | (10.4) |
| 147 | WENNING | | | 0.5 | (MIN) | | | | | | | | |
| 148 | CLAPHAM B. | 3.6 | (0.3) | 5.5 | (4.8) | 3.1 | (1.4) | 4.4 | (1.4) | 1.3 | (0.0) | 3.4 | (14.8) |
| 149 | AUSTWICK B. | | | 0.5 | (MIN) | | | | | | | | |
| 150 | AUSTWICK B. | | | 0.9 | (1.8) | | | | | 0.6 | (0.0) | 0.8 | (6.0) |
| 151 | AUSTWICK B. | | | 0.0 | (0.0) | 0.0 | (0.0) | 2.4 | (1.6) | 0.8 | (MIN) | 0.8 | (3.9) |
| 151B | AUSTWICK B. | | | | | 0.9 | (1.7) | | | | | 0.9 | (1.7) |
| 152 | FEN B. | | | 0.0 | (0.0) | | | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 153 | KEASDEN B. | | | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 154 | HINDBURN | 0.0 | (0.0) | 1.5 | (2.9) | 4.6 | (1.3) | 2.9 | (1.4) | 0.2 | (0.0) | 1.6 | (9.7) |
| 155 | HINDBURN | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 156 | HINDBURN | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 157 | ROEBURN | 0.8 | (1.5) | 6.9 | (0.8) | 7.6 | (2.0) | 2.1 | (1.5) | 0.0 | (0.0) | 2.6 | (13.3) |
| 158 | ROEBURN | 0.0 | (0.0) | 0.0 | (0.0) | 0.6 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (0.5) |

A 19+
B 10-19
C 5-10
D 3-5
E 0-3
F 0

Appendix 4 LUNE CATCHMENT ELECTROFISHING SURVEY 1981-85
0+ TROUT N/100m2 (95% CL)

| Site | Name | 1981 | 1982 | 1983 | 1984 | 1985 | MEAN |
|---|---|---|---|---|---|---|---|
| 17 | TEBAY | | 1.1 (MIN) | 5.0 (1.0) | 1.1 (1.4) | 0.9 (1.2) | 1.9 (14.4) |
| 18 | OLD TEBAY BR | 1.3 (MIN) | 6.9 (1.5) | 12.8 (2.8) | 2.1 (3.8) | 2.5 (3.2) | 5.9 (33.5) |
| 19 | RAYNE BR | 2.5 (0.2) | 3.0 (MIN) | 7.3 (2.2) | 15.5 (8.9) | 2.1 (MIN) | 6.8 (19.9) |
| 20 | KELLETH BR | 0.2 (MIN) | 13.3 (MIN) | 35.7 (15.1) | 28.8 (8.6) | 8.8 (MIN) | 32.3 (38.4) |
| 21 | WATH | 5.9 (0.7) | 41.8 (18.6) | 77.8 (7.8) | 106.6 (13.9) | 8.0 (2.2) | 34.5 (94.8) |
| 101 | WEASDALE B. | | 102.6 (39.2) | 76.5 (1.6) | 245.8 (54.4) | 0.0 (0.0) | 113.9 (216.6) |
| 102 | BOWDERDALE | | 15.8 (7.6) | 34.4 (MIN) | 127.1 (52.9) | 22.6 (16.5) | 41.5 (137.8) |
| 103 | BOWDERDALE | 0.9 (MIN) | 18.9 (5.9) | 75.3 (MIN) | 49.6 (3.5) | 63.5 (65.6) | 43.4 (121.9) |
| 104 | LONGDALE B. | 1.3 (MIN) | 33.8 (20.6) | 37.1 (MIN) | 73.2 (22.3) | 15.0 (MIN) | 42.9 (82.6) |
| 105 | ELLERGILL B. | | 45.3 (11.9) | 94.0 (27.2) | 9.1 (MIN) | | 67.1 (77.4) |
| 106 | RAIS B. | 2.3 (MIN) | 2.9 (1.9) | 0.5 (0.0) | 1.0 (0.0) | 9.5 (6.8) | 2.6 (10.6) |
| 107 | TEBAY GILL | | 0.0 (0.0) | 0.0 (0.0) | 2.1 (0.0) | 361.2 (147.3) | 63.5 (375.5) |
| 108 | CHAPEL B. | | 46.4 (14.7) | 17.7 (7.6) | 25.9 (5.5) | 116.9 (33.9) | 42.5 (110.8) |
| 11 | 4 LANE ENDS | | 0.3 (0.0) | | | | 0.3 (0.0) |
| 11A | PARK WOOD | | | 0.9 (0.6) | 0.2 (MIN) | 0.4 (MIN) | 0.9 (0.6) |
| 12 | LINCOLN INN | 0.0 (0.0) | 1.2 (MIN) | 19.3 (3.2) | 1.6 (MIN) | 1.6 (MIN) | 6.7 (29.1) |
| 13 | THWAITES | | 0.9 (MIN) | 6.1 (1.7) | 3.9 (MIN) | 2.7 (MIN) | 6.1 (1.7) |
| 14 | FLEETHOLME | 0.0 (0.0) | 0.1 (0.0) | 2.6 (0.8) | 0.1 (0.0) | 0.1 (0.0) | 0.3 (3.9) |
| 15 | FAIRMILE | 0.0 (0.0) | 0.8 (MIN) | 1.6 (0.2) | 0.1 (0.1) | 1.1 (MIN) | 0.5 (2.7) |
| 16 | YORKSHIRE BR | | 0.9 (1.9) | 3.8 (0.8) | 0.8 (1.1) | 0.0 (0.0) | 1.3 (7.8) |
| 6 | KIRBY LOND. | 0.0 (0.0) | 0.0 (0.0) | 0.2 (0.0) | 0.3 (MIN) | 0.0 (0.0) | 0.03 (0.2) |
| 7 | LINDERLAY | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.1 (0.0) | 0.0 (0.0) | 0.01 (0.1) |
| 8 | RIGMADEN | | 0.0 (0.0) | 0.2 (0.0) | 0.2 (0.5) | 0.3 (0.0) | 0.2 (6.0) |
| 9 | MIDDLETON | 0.0 (0.0) | 0.0 (0.0) | 0.1 (0.0) | 0.0 (0.0) | 0.1 (0.0) | 0.03 (0.1) |
| 10 | HALLBECK | 0.0 (0.0) | 0.0 (0.0) | 0.2 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.02 (0.2) |
| 1 | CATON | 0.0 (0.0) | 0.0 (0.0) | 0.5 (MIN) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 2 | SNAB | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 3 | GRESSINGHAM | 0.0 (0.0) | 0.1 (0.1) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.01 (0.1) |
| 4 | NEWTON | 0.0 (0.0) | 0.0 (0.0) | 0.4 (0.0) | 0.1 (MIN) | 0.1 (0.0) | 0.08 (0.4) |
| 5 | WHITTINGTON | 0.0 (0.0) | 0.0 (0.0) | 0.8 (MIN) | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 109 | BIRK B. | 12.9 (MIN) | 11.9 (2.5) | 15.6 (MIN) | 24.8 (22.2) | 0.7 (MIN) | 16.4 (53.6) |
| 110 | BIRK B. | 4.8 (2.3) | 15.8 (4.7) | 15.5 (1.8) | 41.3 (15.7) | 17.2 (MIN) | 15.2 (54.5) |
| 111 | BIRK B. | | 7.8 (1.7) | 3.9 (0.0) | 0.7 (0.0) | 1.3 (2.5) | 4.1 (9.5) |
| 112 | BRETHERDALE | | 36.2 (12.3) | 61.4 (2.8) | 57.9 (10.6) | 31.9 (30.9) | 46.4 (103.4) |
| 113 | BORROW B. | 2.9 (MIN) | 35.3 (7.3) | 17.7 (1.4) | 12.5 (24.4) | 4.0 (MIN) | 20.7 (66.7) |
| 114 | BORROW B. | | 21.8 (6.4) | 5.8 (MIN) | 41.8 (41.8) | 8.7 (MIN) | 33.2 (106.4) |
| 115 | CHAPEL B. | | 36.4 (8.7) | 24.4 (7.2) | 113.1 (40.8) | 89.4 (6.9) | 56.8 (90.4) |
| 116 | CROSDALE B. | | 502.1 (93.4) | 63.7 (MIN) | 349.8 (173.9) | 432.2 (33.2) | 426.6 (167.3) |
| 117 | INGMIRE | 0.0 (0.0) | 0.9 (0.2) | 3.1 (1.5) | 0.2 (0.4) | 0.1 (0.0) | 0.9 (13.4) |
| 118 | SEDBERGH | 0.0 (0.0) | 5.9 (1.3) | 7.5 (0.8) | 5.0 (6.5) | 3.1 (MIN) | 4.5 (21.6) |
| 119 | BURNT MILL | 0.5 (MIN) | 5.3 (2.7) | 8.6 (4.8) | 6.0 (MIN) | 0.5 (0.0) | 6.5 (28.2) |
| 119A | CAUTLEY | | | 6.4 (1.5) | 12.5 (2.2) | 4.3 (4.5) | 6.9 (23.1) |
| 120 | RAWTHEY | 1.9 (MIN) | 20.4 (4.6) | 18.2 (12.1) | 32.8 (10.1) | 20.2 (13.9) | 23.9 (97.4) |
| 121 | CLOUGH | 0.9 (MIN) | 2.9 (MIN) | 14.5 (4.1) | 40.3 (9.3) | 3.3 (5.0) | 12.5 (56.2) |
| 122 | CLOUGH | 3.1 (1.0) | 57.1 (14.4) | 42.1 (4.9) | 127.9 (62.9) | 10.9 (5.2) | 25.3 (127.1) |
| 123 | CLOUGH | 7.7 (1.5) | 116.3 (28.9) | 18.5 (3.3) | 27.5 (4.3) | 7.6 (7.8) | 22.6 (107.5) |
| 124 | DEE | 0.0 (0.0) | 0.0 (0.0) | 8.7 (4.3) | 10.3 (2.3) | 1.1 (MIN) | 3.9 (26.8) |
| 125 | DEE | 0.0 (0.0) | 31.5 (7.2) | 19.4 (4.7) | 9.9 (2.5) | 11.2 (19.6) | 13.5 (58.6) |
| 126 | DEE | 2.2 (2.3) | 8.6 (3.2) | 24.0 (4.2) | 25.5 (8.4) | 1.3 (MIN) | 17.8 (54.8) |
| 127 | DEE | 19.7 (1.9) | 31.3 (5.6) | 65.9 (12.3) | 109.6 (9.3) | 10.5 (MIN) | 42.7 (104.9) |
| 128 | BARBON B. | 0.0 (0.0) | 14.7 (1.4) | 15.2 (20.6) | 32.1 (12.6) | 15.8 (7.6) | 12.1 (95.1) |
| 129 | BARBON B. | 5.5 (0.6) | 28.6 (9.0) | 23.8 (3.1) | 16.2 (4.5) | 15.5 (10.3) | 15.8 (51.4) |
| 130 | BARBON B. | 1.3 (0.1) | 3.1 (MIN) | 6.0 (3.0) | 3.5 (2.3) | 0.3 (0.0) | 2.1 (10.1) |
| 131 | LECK BECK | 0.2 (MIN) | 6.2 (3.0) | 24.2 (9.0) | 11.0 (2.0) | 7.8 (5.2) | 11.2 (38.3) |
| 132 | LECK BECK | 1.0 (MIN) | 0.0 (0.0) | 48.7 (5.1) | 44.1 (6.3) | 7.4 (MIN) | 33.2 (56.9) |
| 133 | GRETA | 0.2 (0.3) | 0.0 (0.0) | 1.6 (2.0) | 1.4 (MIN) | 2.1 (0.7) | 0.9 (10.2) |
| 134 | GRETA | 0.0 (0.0) | 0.0 (0.0) | 1.8 (1.2) | 2.7 (0.4) | 1.0 (0.0) | 1.2 (8.6) |
| 135 | GRETA | 0.0 (0.0) | 6.8 (7.1) | 4.7 (1.4) | 0.4 (0.0) | 2.0 (2.6) | 2.7 (24.0) |
| 136 | GRETA | | 20.1 (4.2) | 96.2 (19.3) | 13.4 (1.6) | 16.4 (6.1) | 29.3 (113.9) |
| 137 | DOE | | 0.6 (MIN) | 2.2 (2.8) | 1.6 (2.0) | 1.3 (0.0) | 1.7 (12.9) |
| 137A | DOE | | | 0.0 (0.0) | | | 0.0 (0.0) |
| 138 | GRETA | | 0.0 (0.0) | 16.3 (6.7) | 6.7 (8.1) | 0.7 (0.0) | 7.5 (37.8) |
| 139 | WENNING | 0.0 (0.0) | 0.0 (0.0) | 0.1 (0.3) | 0.2 (0.0) | 0.0 (0.0) | 0.06 (2.5) |
| 140 | WENNING | 0.0 (0.0) | 0.0 (0.0) | 1.9 (0.4) | 0.0 (0.0) | 0.7 (0.5) | 0.5 (4.8) |
| 141 | WENNING | | 0.0 (0.0) | | | | 0.0 (0.0) |
| 142 | WENNING | | 0.7 (1.3) | 7.0 (2.7) | 0.2 (0.0) | 0.4 (0.0) | 2.1 (16.8) |
| 143 | WENNING | | 1.7 (MIN) | 3.9 (2.7) | 0.4 (0.0) | 0.0 (0.0) | 1.4 (9.1) |
| 144 | WENNING | | 8.6 (9.1) | 20.8 (4.6) | 0.0 (0.0) | 4.7 (3.3) | 7.4 (35.6) |
| 145 | WENNING | 0.9 (0.2) | 10.7 (2.4) | 8.1 (2.1) | 11.1 (8.1) | 16.2 (11.8) | 8.0 (47.9) |
| 146 | WENNING | 4.9 (1.6) | 6.6 (1.0) | 26.5 (5.1) | 20.6 (3.7) | 36.5 (8.8) | 17.7 (54.5) |
| 147 | WENNING | | 3.9 (MIN) | | | | 0.0 (0.0) |
| 148 | CLAPHAM B. | 4.4 (1.8) | 22.2 (6.6) | 15.9 (5.9) | 65.3 (11.3) | 17.4 (MIN) | 22.6 (64.7) |
| 149 | AUSTWICK B. | | 2.1 (MIN) | | | | 0.0 (0.0) |
| 150 | AUSTWICK B. | | 24.1 (7.6) | | | 100.0 (26.8) | 50.0 (124.6) |
| 151 | AUSTWICK B. | | 116.2 (7.6) | 203.4 (18.9) | 73.4 (43.3) | 72.9 (MIN) | 138.7 (157.9) |
| 151B | AUSTWICK B. | | | 12.8 (3.9) | | | 12.8 (0.0) |
| 152 | FEN B. | | 12.5 (MIN) | | 0.0 (0.0) | 25.0 (0.0) | 8.5 (37.1) |
| 153 | KEASDEN B. | | 24.6 (7.6) | 15.5 (11.3) | 1.9 (3.7) | 2.8 (0.0) | 9.7 (33.8) |
| 154 | HINDBURN | 0.2 (0.0) | 2.5 (0.5) | 10.5 (0.8) | 1.0 (2.0) | 1.8 (0.0) | 3.1 (10.9) |
| 155 | HINDBURN | 0.4 (MIN) | 18.6 (10.1) | 33.1 (9.9) | 1.4 (4.6) | 12.0 (6.5) | 14.3 (66.5) |
| 156 | HINDBURN | 0.0 (0.0) | 48.0 (14.3) | 40.6 (0.0) | 5.8 (7.5) | 6.9 (MIN) | 24.8 (52.7) |
| 157 | ROEBURN | 4.6 (1.3) | 29.6 (11.9) | 28.9 (5.2) | 3.0 (3.1) | 8.5 (5.1) | 12.7 (58.1) |
| 158 | ROEBURN | 13.9 (3.0) | 79.2 (30.9) | 69.5 (53.3) | 4.8 (3.4) | 57.1 (22.6) | 36.2 (132.0) |

A 38+
B 17-38
C 8-17
D 3-8
E 0-3
F 0

Appendix 5 RIVER LUNE CATCHMENT ELECTROFISHING SURVEY 1981-85
1+ TROUT N/100m2 (95% CL)

| Site | Name | 1981 | | 1982 | | 1983 | | 1984 | | 1985 | | MEAN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | TEBAY | | | 1.3 | (0.7) | 0.8 | (1.5) | 2.3 | (2.0) | 1.6 | (0.8) | 1.6 | (16.3) |
| 18 | OLD TEBAY BR | 0.4 | (MIN) | 0.9 | (MIN) | 0.2 | (0.0) | 0.8 | (0.5) | 1.2 | (1.5) | 0.7 | (9.6) |
| 19 | RAYNE BR | 0.3 | (MIN) | 0.4 | (0.0) | 1.1 | (0.0) | 2.7 | (1.8) | 1.3 | (MIN) | 1.2 | (3.6) |
| 20 | KELLETH BR | 1.5 | (1.5) | 7.8 | (1.9) | 5.2 | (9.3) | 3.7 | (2.6) | 2.7 | (3.4) | 3.4 | (23.6) |
| 21 | WATH | 3.8 | (0.5) | 7.9 | (7.6) | 1.9 | (0.0) | 2.7 | (0.0) | 0.0 | (0.0) | 2.7 | (7.3) |
| 101 | WEASDALE B. | | | 11.1 | (4.9) | 5.0 | (0.0) | 14.2 | (10.2) | 1.1 | (0.0) | 6.7 | (13.6) |
| 102 | BOWDERDALE | | | 3.9 | (MIN) | 6.5 | (1.4) | 21.6 | (2.3) | 5.1 | (16.9) | 9.0 | (30.5) |
| 103 | BOWDERDALE | 14.0 | (0.8) | 0.6 | (0.0) | 2.7 | (0.0) | 0.7 | (0.0) | 4.6 | (3.3) | 5.2 | (12.7) |
| 104 | LONGDALE B. | 2.6 | (2.5) | 5.4 | (2.1) | 19.3 | (MIN) | 17.0 | (4.3) | 4.8 | (3.1) | 5.2 | (18.6) |
| 105 | ELLERGILL B. | | | 8.1 | (8.3) | 15.2 | (6.1) | 12.9 | (1.4) | | | 11.7 | (15.3) |
| 106 | RAIS B. | 1.7 | (0.7) | 0.7 | (0.0) | 0.0 | (0.0) | 9.4 | (1.2) | 3.7 | (0.0) | 2.1 | (8.6) |
| 107 | TEBAY GILL | | | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 5.4 | (0.0) | 0.9 | (5.5) |
| 108 | CHAPEL B. | | | 8.8 | (4.4) | 11.7 | (2.2) | 6.1 | (2.8) | 4.9 | (MIN) | 9.8 | (12.4) |
| 11 | 4 LANE ENDS | | | 0.0 | (0.0) | | | | | | | 0.0 | (0.0) |
| 11A | PARK WOOD | | | | | 0.0 | (0.0) | 0.0 | (0.0) | 1.4 | (3.1) | 0.7 | (35.8) |
| 12 | LINCOLN INN | 0.0 | (0.0) | 0.9 | (MIN) | 1.2 | (MIN) | 3.7 | (1.2) | 1.7 | (0.1) | 1.6 | (5.6) |
| 13 | THWAITES | | | 1.1 | (0.0) | 0.4 | (MIN) | 0.5 | (1.1) | 4.4 | (6.7) | 2.4 | (52.7) |
| 14 | FLEETHOLME | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.0) | 0.2 | (0.0) |
| 15 | FAIRMILE | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (0.0) | 0.3 | (0.0) | 1.2 | (0.6) | 0.3 | (6.3) |
| 16 | YORKSHIRE BR | | | 0.9 | (0.7) | 0.0 | (0.0) | 3.9 | (1.9) | 3.8 | (3.9) | 2.3 | (29.3) |
| 6 | KIRBY LOND. | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.2) | 0.1 | (0.0) | 0.1 | (1.8) |
| 7 | LINDERLAY | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 8 | RIGMADEN | | | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.3 | (MIN) | 0.0 | (0.0) |
| 9 | MIDDLETON | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (0.0) | 0.03 | (0.1) |
| 10 | HALLBECK | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.0) | 0.04 | (0.2) |
| 1 | CATON | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.0) | 0.1 | (0.0) | 0.1 | (0.0) |
| 2 | SNAB | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) |
| 3 | GRESSINGHAM | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (MIN) | 0.0 | (0.0) | 0.0 | (0.0) |
| 4 | NEWTON | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (MIN) | 0.2 | (0.5) | 0.2 | (0.5) |
| 5 | WHITTINGTON | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.1 | (0.0) | 0.02 | (0.1) |
| 109 | BIRK B. | 0.9 | (MIN) | 0.3 | (0.0) | 2.7 | (0.7) | 0.5 | (0.0) | 1.0 | (MIN) | 1.0 | (3.2) |
| 110 | BIRK B. | 0.3 | (MIN) | 0.7 | (1.4) | 2.8 | (1.9) | 2.9 | (3.7) | 2.2 | (MIN) | 1.9 | (12.6) |
| 111 | BIRK B. | | | 4.1 | (0.5) | 10.5 | (23.1) | 7.6 | (13.5) | 1.3 | (0.0) | 5.1 | (41.8) |
| 112 | BRETHERDALE | | | 10.9 | (6.7) | 6.4 | (0.3) | 0.9 | (0.0) | 2.4 | (7.9) | 4.6 | (28.0) |
| 113 | BORROW B. | 1.7 | (MIN) | 0.5 | (MIN) | 6.1 | (0.0) | 10.4 | (3.2) | 0.4 | (0.0) | 4.4 | (13.2) |
| 114 | BORROW B. | | | 3.9 | (0.2) | 6.5 | (2.6) | 7.9 | (0.6) | 1.9 | (MIN) | 6.3 | (8.1) |
| 115 | CHAPEL B. | | | 1.3 | (0.0) | 19.9 | (4.0) | 23.0 | (2.4) | 14.0 | (9.0) | 17.0 | (25.1) |
| 116 | CROSDALE B. | | | 10.0 | (19.6) | 20.6 | (3.4) | 35.0 | (8.8) | 53.3 | (3.4) | 31.4 | (38.6) |
| 117 | INGMIRE | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.0) | 0.9 | (MIN) | 0.03 | (0.2) |
| 118 | SEDBERGH | 2.2 | (0.1) | 0.8 | (1.5) | 6.2 | (1.1) | 3.4 | (0.7) | 3.8 | (0.4) | 3.2 | (8.9) |
| 119 | BURNT MILL | 2.8 | (MIN) | 3.7 | (3.9) | 8.6 | (4.8) | 7.3 | (MIN) | 5.1 | (1.0) | 6.3 | (29.8) |
| 119A | CAUTLEY | | | | | 3.1 | (1.0) | 6.4 | (4.1) | 0.2 | (0.0) | 2.6 | (12.4) |
| 120 | RAWTHEY | 3.8 | (0.4) | 1.2 | (0.9) | 2.6 | (1.2) | 4.5 | (1.8) | 5.3 | (1.2) | 3.3 | (14.6) |
| 121 | CLOUGH | 3.8 | (0.5) | 2.2 | (MIN) | 1.2 | (0.8) | 5.4 | (1.7) | 1.5 | (0.2) | 2.6 | (6.6) |
| 122 | CLOUGH | 4.5 | (0.8) | 30.9 | (8.6) | 23.3 | (1.9) | 39.1 | (8.3) | 5.3 | (1.2) | 13.2 | (40.7) |
| 123 | CLOUGH | 3.2 | (1.6) | 23.0 | (2.4) | 18.3 | (2.5) | 61.9 | (51.2) | 8.6 | (MIN) | 22.7 | (126.1) |
| 124 | DEE | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 1.7 | (0.0) | 0.0 | (0.0) | 0.2 | (1.6) |
| 125 | DEE | 0.0 | (0.0) | 4.5 | (2.2) | 0.2 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 0.8 | (7.4) |
| 126 | DEE | 0.6 | (1.2) | 0.0 | (0.0) | 3.0 | (1.2) | 6.7 | (2.7) | 2.8 | (2.5) | 3.6 | (26.9) |
| 127 | DEE | 4.6 | (3.8) | 10.5 | (2.4) | 18.9 | (8.1) | 26.9 | (2.6) | 10.8 | (MIN) | 13.2 | (45.5) |
| 128 | BARBON B. | 0.0 | (0.0) | 0.0 | (0.0) | 0.2 | (0.0) | 1.0 | (1.8) | 0.0 | (0.0) | 0.2 | (2.4) |
| 129 | BARBON B. | 0.9 | (0.3) | 0.9 | (0.0) | 0.3 | (0.0) | 2.4 | (0.5) | 0.0 | (0.0) | 0.8 | (2.7) |
| 130 | BARBON B. | 5.7 | (1.9) | 6.9 | (0.9) | 4.1 | (7.3) | 34.9 | (11.9) | 7.2 | (0.8) | 7.9 | (37.1) |
| 131 | LECK BECK | 1.3 | (MIN) | 0.6 | (0.0) | 0.0 | (0.0) | 13.5 | (1.5) | 2.4 | (2.5) | 2.6 | (17.6) |
| 132 | LECK BECK | 16.4 | (0.8) | 2.8 | (0.5) | 1.9 | (0.0) | 17.2 | (1.9) | 10.6 | (2.1) | 9.4 | (15.9) |
| 133 | GRETA | 0.3 | (0.0) | 0.0 | (0.0) | 3.5 | (2.3) | 0.7 | (MIN) | 0.9 | (MIN) | 1.2 | (10.8) |
| 134 | GRETA | 0.0 | (0.0) | 0.0 | (0.0) | 0.5 | (0.9) | 0.5 | (MIN) | 0.0 | (0.0) | 0.2 | (6.0) |
| 135 | GRETA | 0.0 | (0.0) | 0.0 | (0.0) | 0.0 | (0.0) | 2.0 | (0.4) | 0.6 | (MIN) | 0.3 | (2.3) |
| 136 | GRETA | | | 13.4 | (2.9) | 10.0 | (15.0) | 16.7 | (1.7) | 1.9 | (0.4) | 9.5 | (54.1) |
| 137 | DOE | | | 0.0 | (0.0) | 0.3 | (0.0) | 0.9 | (0.6) | 1.9 | (0.0) | 0.8 | (3.2) |
| 137A | DOE | | | | | 1.2 | (1.5) | | | | | 1.2 | (1.5) |
| 138 | GRETA | | | 1.7 | (MIN) | 6.3 | (2.5) | 8.4 | (2.6) | 15.9 | (5.8) | 10.3 | (23.5) |
| 139 | WENNING | 0.0 | (0.0) | 0.0 | (0.0) | 2.2 | (1.1) | 1.3 | (4.1) | 1.2 | (MIN) | 0.9 | (25.1) |
| 140 | WENNING | 0.1 | (0.1) | 0.0 | (0.0) | 0.6 | (0.1) | 1.3 | (0.6) | 1.2 | (1.6) | 0.5 | (10.2) |
| 141 | WENNING | | | 0.9 | (MIN) | | | | | | | 0.0 | (0.0) |
| 142 | WENNING | | | 1.6 | (2.0) | 2.5 | (0.9) | 2.2 | (1.1) | 0.2 | (0.0) | 1.7 | (12.3) |
| 143 | WENNING | | | 10.6 | (5.3) | 6.5 | (1.5) | 6.3 | (0.8) | 0.0 | (0.0) | 4.6 | (12.1) |
| 144 | WENNING | | | 21.3 | (3.6) | 12.9 | (1.4) | 12.3 | (0.9) | 3.0 | (2.7) | 10.7 | (22.9) |
| 145 | WENNING | 2.8 | (0.3) | 10.7 | (1.9) | 4.4 | (0.3) | 1.9 | (0.0) | 2.1 | (0.4) | 4.2 | (8.5) |
| 146 | WENNING | 2.7 | (0.2) | 1.5 | (1.5) | 0.5 | (0.9) | 0.3 | (0.0) | 0.4 | (0.0) | 1.1 | (11.2) |
| 147 | WENNING | | | 0.5 | (MIN) | | | | | | | 0.0 | (0.0) |
| 148 | CLAPHAM B. | 7.6 | (0.2) | 11.4 | (0.6) | 10.9 | (1.8) | 3.7 | (MIN) | 6.8 | (MIN) | 9.7 | (6.8) |
| 149 | AUSTWICK B. | | | 0.5 | (MIN) | | | | | | | 0.0 | (0.0) |
| 150 | AUSTWICK B. | | | 1.5 | (0.3) | | | | | 2.9 | (0.0) | 1.9 | (2.3) |
| 151 | AUSTWICK B. | | | 6.4 | (1.1) | 7.6 | (3.8) | 8.4 | (2.5) | 0.8 | (0.0) | 5.3 | (11.3) |
| 151B | AUSTWICK B. | | | | | 5.4 | (5.7) | | | | | 5.4 | (5.7) |
| 152 | FEN B. | | | 7.8 | (0.0) | | | 0.0 | (0.0) | 3.6 | (0.0) | 4.3 | (7.9) |
| 153 | KEASDEN B. | | | 13.9 | (5.6) | 7.7 | (4.9) | 8.1 | (3.1) | 1.6 | (0.0) | 6.7 | (16.8) |
| 154 | HINDBURN | 7.1 | (1.6) | 4.3 | (1.9) | 2.8 | (2.8) | 8.7 | (3.0) | 0.5 | (0.0) | 4.8 | (18.5) |
| 155 | HINDBURN | 11.4 | (1.9) | 21.7 | (6.2) | 9.4 | (2.7) | 14.6 | (2.2) | 9.2 | (6.2) | 12.2 | (43.4) |
| 156 | HINDBURN | 13.7 | (2.7) | 18.1 | (0.0) | 16.5 | (4.1) | 32.7 | (7.8) | 18.5 | (16.2) | 19.2 | (40.6) |
| 157 | ROEBURN | 5.3 | (0.9) | 11.3 | (0.2) | 4.6 | (2.3) | 10.0 | (2.1) | 3.3 | (0.8) | 5.9 | (15.2) |
| 158 | ROEBURN | 9.1 | (1.7) | 33.3 | (12.6) | 13.4 | (3.4) | 17.6 | (3.7) | 5.8 | (2.9) | 12.9 | (30.3) |

A 21+
B 12-21
C 5-12
D 2-5
E 0-2
F 0

APPENDIX 6. 0+ SALMON DATA FROM THE RIVER LUNE, 1981-1985.

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| S081 | 2093.988 | 6 | 5062.042 | 34 | 2.344 | 0.053 |
| S082 | 132409.539 | 6 | 16647.642 | 64 | 84.839 | 0.000 |
| S083 | 268600.613 | 6 | 17935.806 | 64 | 159.740 | 0.000 |
| S084 | 89146.210 | 6 | 20504.462 | 61 | 44.201 | 0.000 |
| S085 | 59606.586 | 6 | 21255.639 | 54 | 25.238 | 0.000 |

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CLUSTER NUMBER: 1

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| D | 101 | Weasdale | 16.73 |
| D | 102 | Bowderdale | 18.03 |
| D | 104 | Longdale B | 4.13 |
| D | 106 | Rais B | 7.75 |
| D | 108 | Chapel B | 8.65 |
| D | 11 | Lane Ends | 5.24 |
| D | 12 | Lincoln Inn | 4.40 |
| D | 13 | Thwaites | 11.68 |
| D | 14 | Fleetholme | 7.66 |
| D | 16 | Yorkshire Br | 7.63 |
| D | 8 | Rigmaden | 3.45 |
| D | 9 | Middleton | 6.61 |
| D | 10 | Hallbeck | 5.04 |
| D | 1 | Caton | 12.25 |
| D | 2 | Snab | 4.69 |
| D | 3 | Gressingham | 24.57 |
| D | 5 | Whittington | 17.50 |
| D | 110 | Birk B | 7.41 |
| D | 111 | Birk B | 4.50 |
| D | 119 | Burnt Mill | 11.63 |
| D | 120 | Rawthey | 8.00 |
| D | 121 | Clough | 8.70 |
| D | 122 | Clough | 7.64 |
| D | 123 | Clough | 11.08 |
| D | 124 | Dee | 10.17 |
| D | 127 | Dee | 3.59 |
| D | 132 | Leck B | 14.06 |
| D | 134 | Greta | 8.49 |
| D | 135 | Greta | 18.45 |
| D | 136 | Greta | 6.60 |
| E | 137 | Doe | 8.94 |
| E | 138 | Greta | 8.94 |
| D | 139 | Wenning | 18.02 |
| D | 140 | Wenning | 6.22 |
| D | 141 | Wenning | 7.24 |
| E | 142 | Wenning | 8.94 |
| E | 143 | Wenning | 8.94 |
| D | 144 | Wenning | 8.50 |
| D | 145 | Wenning | 2.46 |
| D | 151 | Austwick B | 11.88 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S081 | 0.00 | 1.58 | 12.30 | 2.91 |
| S082 | 0.00 | 11.54 | 43.90 | 11.51 |
| S083 | 0.00 | 10.70 | 57.10 | 14.25 |
| S084 | 0.00 | 6.13 | 33.90 | 8.44 |
| S085 | 0.00 | 5.85 | 39.90 | 9.19 |

Appendix 6. (Cont.)

| | | | |
|---|---|---|---|
| D | 152 | Fen B | 6.21 |
| E | 153 | Keasden B | 8.94 |
| D | 154 | Hindburn | 9.43 |
| E | 155 | Hindburn | 8.02 |
| E | 156 | Hindburn | 8.02 |
| D | 157 | Roeburn | 9.91 |
| E | 158 | Roeburn | 8.02 |

CLUSTER NUMBER: 2

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A | 107 Tebay Gill | 0.00 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S082 | 43.70 | 43.70 | 43.70 | 0.00 |
| | | | S083 | 505.60 | 505.60 | 505.60 | 0.00 |
| | | | S084 | 113.10 | 113.10 | 113.10 | 0.00 |
| | | | S085 | 0.00 | 0.00 | 0.00 | 0.00 |

CLUSTER NUMBER: 3

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B | 128 Barbon B | 0.00 | S081 | 15.00 | 15.00 | 15.00 | 0.00 |
| | | | S082 | 223.20 | 223.20 | 223.20 | 0.00 |
| | | | S083 | 69.70 | 69.70 | 69.70 | 0.00 |
| | | | S084 | 279.90 | 279.90 | 279.90 | 0.00 |
| | | | S085 | 152.90 | 152.90 | 152.90 | 0.00 |

CLUSTER NUMBER: 4

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D | 6 K Lonsdale | 4.80 | S081 | 1.40 | 4.80 | 8.20 | 3.40 |
| C | 113 Borrow B | 9.16 | S082 | 74.90 | 110.35 | 139.60 | 23.62 |
| C | 114 Borrow B | 20.80 | S083 | 4.60 | 28.03 | 55.10 | 14.91 |
| C | 119A Cautley | 14.23 | S084 | 0.00 | 13.34 | 35.60 | 14.05 |
| D | 126 Dee | 19.96 | S085 | 3.40 | 11.95 | 22.50 | 7.77 |
| D | 130 Barbon B | 18.11 | | | | | |
| D | 150 Austwick B | 1.95 | | | | | |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B | 103 Bowderdale | 0.00 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S082 | 33.90 | 33.90 | 33.90 | 0.00 |
| | | | S083 | 143.40 | 143.40 | 143.40 | 0.00 |
| | | | S084 | 2.00 | 2.00 | 2.00 | 0.00 |

Appendix 6. (Cont.)

| | | | | | |
|---|---|---|---|---|---|
| | | | S085 | 152.60 | 152.60 | 152.60 | 0.00 |

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C | 17 Tebay | 15.45 | S081 | 0.00 | 17.98 | 64.70 | 21.95 |
| B | 18 Old Tebay | 18.70 | S082 | 11.30 | 46.55 | 104.30 | 22.62 |
| B | 19 Rayne Br | 21.04 | S083 | 15.00 | 53.28 | 104.40 | 21.70 |
| C | 20 Kelleth Br | 14.98 | S084 | 4.20 | 34.90 | 103.50 | 30.49 |
| C | 21 Wath | 30.34 | S085 | 18.90 | 53.07 | 133.60 | 34.50 |
| D | 11A Park Wood | 18.95 | | | | | |
| D | 7 Linderlay | 19.13 | | | | | |
| C | 4 Newton | 20.59 | | | | | |
| C | 109 Birk B | 32.35 | | | | | |
| C | 112 Bretherdale | 22.34 | | | | | |
| B | 115 Chapel B | 38.01 | | | | | |
| C | 117 Ingmire | 17.46 | | | | | |
| C | 118 Sedbergh | 28.39 | | | | | |
| B | 125 Dee | 25.81 | | | | | |
| B | 129 Barbon B | 43.79 | | | | | |
| D | 131 Leck B | 10.20 | | | | | |
| D | 133 Greta | 17.07 | | | | | |
| D | 146 Wenning | 42.68 | | | | | |

CLUSTER NUMBER: 7

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D | 105 Ellergill | 0.83 | S081 | 0.50 | 0.50 | 0.50 | 0.00 |
| D | 15 Fairmile | 0.05 | S082 | 251.30 | 251.30 | 251.30 | 0.00 |
| B | 116 Crosdale B | 0.10 | S083 | 0.00 | 0.08 | 0.30 | 0.13 |
| E | 137A Doe | 0.08 | S084 | 1.40 | 2.73 | 3.90 | 1.03 |
| D | 148 Clapham B | 0.94 | S085 | 0.00 | 0.00 | 0.00 | 0.00 |
| D | 151B Austwick B | 0.23 | | | | | |

APPENDIX 7. 1+ SALMON DATA FOR THE RIVER LUNE, 1981-1985

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| S181 | 1802.069 | 6 | 778.861 | 41 | 15.810 | 0.000 |
| S182 | 1339.597 | 6 | 1158.451 | 64 | 12.335 | 0.000 |
| S183 | 7634.696 | 6 | 1300.386 | 66 | 64.582 | 0.000 |
| S184 | 12713.154 | 6 | 2307.806 | 67 | 61.515 | 0.000 |
| S185 | 1866.036 | 6 | 716.074 | 62 | 26.928 | 0.000 |

CLUSTER NUMBER: 1

| MEMBERS | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|
| CLASS | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D | 17 | Tebay | 1.08 | S181 | 0.00 | 3.17 | 11.30 | 3.40 |
| D | 18 | Old Tebay | 3.06 | S182 | 0.00 | 2.45 | 17.40 | 3.78 |
| C | 21 | Wath | 7.28 | S183 | 0.00 | 2.65 | 13.80 | 2.91 |
| C | 106 | Rais B | 5.55 | S184 | 0.00 | 3.85 | 16.30 | 3.93 |
| C | 108 | Chapel B | 3.64 | S185 | 0.00 | 1.70 | 12.40 | 2.43 |
| D | 11a | Park Wood | 1.62 | | | | | |
| D | 14 | Fleetholme | 1.81 | | | | | |
| D | 15 | Fairmile | 0.96 | | | | | |
| D | 6 | K Lonsdale | 1.54 | | | | | |
| D | 7 | Linderlay | 2.38 | | | | | |
| D | 8 | Rigmaden | 1.90 | | | | | |
| D | 9 | Middleton | 1.24 | | | | | |
| D | 10 | Hallbeck | 3.76 | | | | | |
| D | 1 | Caton | 2.41 | | | | | |
| D | 2 | Snab | 2.90 | | | | | |
| E | 3 | Gressingham | 2.30 | | | | | |
| D | 4 | Newton | 1.78 | | | | | |
| C | 109 | Birk B | 4.32 | | | | | |
| C | 112 | Bretherdale | 7.29 | | | | | |
| D | 117 | Ingmire | 2.53 | | | | | |
| D | 119a | Cautley | 1.43 | | | | | |
| D | 120 | Rawthey | 3.85 | | | | | |
| C | 121 | Clough | 1.72 | | | | | |
| D | 122 | Clough | 2.79 | | | | | |
| D | 123 | Clough | 2.55 | | | | | |
| D | 125 | Dee | 2.14 | | | | | |
| D | 126 | Dee | 3.13 | | | | | |
| C | 127 | Dee | 4.54 | | | | | |
| C | 128 | Barbon B | 3.97 | | | | | |
| D | 133 | Greta | 6.43 | | | | | |
| D | 134 | Greta | 4.83 | | | | | |
| E | 137 | Doe | 2.77 | | | | | |
| D | 138 | Greta | 2.65 | | | | | |
| D | 139 | Wenning | 4.79 | | | | | |
| D | 140 | Wenning | 2.34 | | | | | |
| D | 142 | Wenning | 2.70 | | | | | |
| D | 143 | Wenning | 2.42 | | | | | |
| D | 144 | Wenning | 2.97 | | | | | |
| D | 145 | Wenning | 1.59 | | | | | |
| D | 146 | Wenning | 2.22 | | | | | |

Appendix 7. (Cont.)

| | | | |
|---|---|---|---|
| D | 148 | Clapham B | 1.43 |
| D | 151 | Austwick B | 2.24 |
| E | 153 | Keasden B | 2.77 |
| D | 154 | Hindburn | 1.89 |
| E | 155 | Hindburn | 2.86 |
| E | 156 | Hindburn | 2.86 |
| D | 157 | Roeburn | 3.34 |
| D | 158 | Roeburn | 2.75 |

CLUSTER NUMBER: 2

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| C | 19 | Rayne Br | 4.67 |
| B | 20 | Kelleth Br | 6.93 |
| B | 101 | Weasdale | 10.46 |
| B | 102 | Bowderdale | 5.14 |
| C | 103 | Bowderdale | 8.67 |
| C | 12 | Lincoln Inn | 4.49 |
| C | 13 | Thwaites | 4.15 |
| B | 16 | Yorkshire Br | 7.11 |
| C | 110 | Birk B | 4.88 |
| B | 113 | Borrow B | 5.44 |
| B | 114 | Borrow B | 9.33 |
| C | 119 | Burnt Mill | 4.90 |
| C | 124 | Dee | 3.04 |
| C | 129 | Barbon B | 3.35 |
| B | 131 | Leck B | 11.06 |
| B | 132 | Leck B | 6.46 |
| B | 135 | Greta | 6.87 |
| B | 136 | Greta | 4.96 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S181 | 4.90 | 12.35 | 25.10 | 6.01 |
| S182 | 1.10 | 7.37 | 22.60 | 5.29 |
| S183 | 0.90 | 9.26 | 24.20 | 6.51 |
| S184 | 7.40 | 19.24 | 43.30 | 8.94 |
| S185 | 1.10 | 6.81 | 17.10 | 5.05 |

CLUSTER NUMBER: 3

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| B | 104 | Longdale B | 0.10 |
| A | 107 | Tebay Gill | 0.12 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S181 | 14.20 | 14.20 | 14.20 | 0.00 |
| S182 | 7.50 | 7.70 | 7.90 | 0.20 |
| S183 | 70.20 | 70.20 | 70.20 | 0.00 |
| S184 | 61.60 | 61.60 | 61.60 | 0.00 |
| S185 | 3.80 | 3.80 | 3.80 | 0.00 |

CLUSTER NUMBER: 4

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| B | 105 | Ellergill | 2.88 |
| D | 5 | Whittington | 0.84 |
| D | 150 | Austwick B | 0.66 |
| E | 152 | Fen B | 1.55 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S181 | 0.60 | 0.60 | 0.60 | 0.00 |
| S182 | 0.00 | 1.77 | 5.60 | 2.23 |
| S183 | 44.60 | 44.60 | 44.60 | 0.00 |
| S184 | 0.00 | 2.00 | 5.20 | 2.29 |

Appendix 7. (Cont.)

| | | | | |
|---|---|---|---|---|
| | S185 | 0.00 | 0.27 | 0.60 | 0.25 |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D 11 | Lane Ends | 0.15 | S181 | 0.00 | 0.00 | 0.00 | 0.00 |
| B 115 | Chapel B | 0.87 | S182 | 0.00 | 0.15 | 0.30 | 0.15 |
| E 137a | Doe | 1.20 | S183 | 0.00 | 1.20 | 2.70 | 1.12 |
| E 141 | Wenning | 0.15 | S184 | 23.50 | 23.50 | 23.50 | 0.00 |
| D 151b | Austwick B | 0.30 | S185 | 39.90 | 39.90 | 39.90 | 0.00 |

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B 130 | Barbon B | 0.00 | S181 | 21.30 | 21.30 | 21.30 | 0.00 |
| | | | S182 | 33.90 | 33.90 | 33.90 | 0.00 |
| | | | S183 | 14.90 | 14.90 | 14.90 | 0.00 |
| | | | S184 | 38.40 | 38.40 | 38.40 | 0.00 |
| | | | S185 | 15.90 | 15.90 | 15.90 | 0.00 |

CLUSTER NUMBER: 7

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B 111 | Birk B | 6.20 | S181 | 33.80 | 33.80 | 33.80 | 0.00 |
| B 116 | Crosdale B | 6.77 | S182 | 3.70 | 9.20 | 13.30 | 4.04 |
| A 118 | Sedbergh | 2.36 | S183 | 16.40 | 26.17 | 31.40 | 6.91 |
| | | | S184 | 33.20 | 41.97 | 50.10 | 6.91 |
| | | | S185 | 2.90 | 7.30 | 9.50 | 3.11 |

APPENDIX 8. 0+ TROUT DATA FROM THE RIVER LUNE, 1981-1985.

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| T081 | 357.712 | 6 | 283.997 | 32 | 6.718 | 0.000 |
| T082 | 266908.582 | 6 | 8383.817 | 58 | 307.750 | 0.000 |
| T083 | 49039.839 | 6 | 21303.231 | 62 | 23.787 | 0.000 |
| T084 | 206069.518 | 6 | 19446.693 | 61 | 107.732 | 0.000 |
| T085 | 303591.012 | 6 | 17435.984 | 50 | 145.098 | 0.000 |

---

CLUSTER NUMBER: 1

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| D | 17 | Tebay | 6.73 |
| D | 18 | Old Tebay | 3.66 |
| D | 19 | Rayne Br | 5.25 |
| D | 106 | Rais B | 8.20 |
| D | 12 | Lincoln Inn | 4.57 |
| D | 14 | Fleetholme | 7.58 |
| D | 16 | Yorkshire Br | 7.72 |
| D | 6 | K Lonsdale | 8.28 |
| D | 7 | Linderlay | 8.37 |
| D | 8 | Rigmaden | 9.21 |
| D | 9 | Middleton | 8.35 |
| D | 10 | Hallbeck | 8.33 |
| E | 1 | Caton | 6.80 |
| E | 2 | Snab | 8.39 |
| D | 3 | Gressingham | 8.37 |
| D | 4 | Newton | 8.19 |
| E | 5 | Whittington | 6.80 |
| D | 109 | Birk B | 11.67 |
| D | 110 | Birk B | 16.88 |
| D | 111 | Birk B | 6.31 |
| D | 113 | Borrow B | 15.48 |
| C | 114 | Borrow B | 25.16 |
| D | 117 | Ingmire | 7.23 |
| D | 119 | Burnt Mill | 4.31 |
| D | 119a | Cautley | 4.44 |
| D | 120 | Rawthey | 15.56 |
| D | 125 | Dee | 10.75 |
| D | 126 | Dee | 10.17 |
| D | 128 | Barbon B | 11.88 |
| D | 129 | Barbon B | 11.67 |
| D | 130 | Barbon B | 4.92 |
| D | 131 | Leck B | 6.12 |
| C | 132 | Leck B | 25.65 |
| D | 133 | Greta | 7.47 |
| D | 134 | Greta | 7.22 |
| D | 135 | Greta | 5.48 |
| C | 136 | Greta | 42.44 |
| D | 137 | Doe | 7.69 |
| D | 138 | Greta | 3.41 |
| D | 139 | Wenning | 8.32 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| T081 | 0.00 | 0.94 | 5.50 | 1.70 |
| T082 | 0.00 | 9.22 | 48.00 | 11.79 |
| T083 | 0.00 | 12.91 | 96.20 | 16.84 |
| T084 | 0.00 | 8.51 | 44.10 | 12.42 |
| T085 | 0.00 | 5.18 | 36.50 | 8.07 |

Appendix 8. (Cont.)

| | | | |
|---|---|---|---|
| D | 140 | Wenning | 7.74 |
| D | 142 | Wenning | 7.06 |
| D | 143 | Wenning | 7.61 |
| D | 144 | Wenning | 5.82 |
| D | 145 | Wenning | 5.54 |
| D | 146 | Wenning | 16.34 |
| D | 152 | Fen B | 15.26 |
| D | 153 | Keasden B | 8.55 |
| D | 154 | Hindburn | 4.89 |
| D | 155 | Hindburn | 12.17 |
| D | 156 | Hindburn | 23.87 |
| D | 157 | Roeburn | 12.05 |

CLUSTER NUMBER: 2

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| A | 116 | Crosdale B | 0.00 |
| D | 151B | Austwick B | 0.00 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| T082 | 502.10 | 502.10 | 502.10 | 0.00 |
| T083 | 12.80 | 12.80 | 12.80 | 0.00 |
| T084 | 349.80 | 349.80 | 349.80 | 0.00 |
| T085 | 432.20 | 432.20 | 432.20 | 0.00 |

CLUSTER NUMBER: 3

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| B | 107 | Tebay Gill | 2.19 |
| D | 11 | Lane Ends | 0.94 |
| D | 11A | Park Wood | 2.64 |
| D | 13 | Thwaites | 2.56 |
| D | 15 | Fairmile | 2.71 |
| D | 118 | Sedbergh | 3.07 |
| D | 124 | Dee | 3.98 |
| E | 137A | Doe | 3.54 |
| E | 141 | Wenning | 1.24 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| T082 | 0.00 | 1.24 | 5.90 | 2.33 |
| T083 | 0.00 | 3.54 | 8.70 | 3.48 |
| T084 | 0.10 | 4.38 | 10.30 | 3.84 |
| T085 | 361.20 | 361.20 | 361.20 | 0.00 |

CLUSTER NUMBER: 4

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| C | 21 | Wath | 26.57 |
| C | 102 | Bowderdale | 32.31 |
| C | 103 | Bowderdale | 23.05 |
| C | 104 | Longdale B | 8.78 |
| B | 105 | Ellergill | 32.17 |
| C | 108 | Chapel B | 46.20 |
| C | 112 | Bretherdale | 19.09 |
| B | 115 | Chapel B | 25.33 |
| C | 122 | Clough | 29.61 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| T081 | 3.10 | 8.28 | 19.70 | 6.67 |
| T082 | 15.80 | 34.11 | 57.10 | 11.87 |
| T083 | 15.90 | 49.90 | 94.00 | 27.42 |
| T084 | 25.90 | 85.62 | 127.90 | 33.88 |
| T085 | 8.00 | 55.40 | 116.90 | 40.08 |

Appendix 8. (Cont.)

| | | | |
|---|---|---|---|
| C | 127 | Dee | 15.57 |
| D | 148 | Clapham B | 20.77 |
| C | 150 | Austwick B | 32.32 |

CLUSTER NUMBER: 5

| MEMBERS | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|
| CLASS | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A | 151 | Austwick B | 0.00 | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | T082 | 116.20 | 116.20 | 116.20 | 0.00 |
| | | | | T083 | 203.40 | 203.40 | 203.40 | 0.00 |
| | | | | T084 | 73.40 | 73.40 | 73.40 | 0.00 |
| | | | | T085 | 0.00 | 0.00 | 0.00 | 0.00 |

CLUSTER NUMBER: 6

| MEMBERS | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|
| CLASS | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A | 101 | Weasdale | 0.00 | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | T082 | 102.60 | 102.60 | 102.60 | 0.00 |
| | | | | T083 | 76.50 | 76.50 | 76.50 | 0.00 |
| | | | | T084 | 245.80 | 245.80 | 245.80 | 0.00 |
| | | | | T085 | 0.00 | 0.00 | 0.00 | 0.00 |

CLUSTER NUMBER: 7

| MEMBERS | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|
| CLASS | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C | 20 | Kelleth Br | 2.57 | T081 | 7.70 | 10.80 | 13.90 | 3.10 |
| D | 121 | Clough | 18.26 | T082 | 79.20 | 97.75 | 116.30 | 18.55 |
| D | 123 | Clough | 12.98 | T083 | 14.50 | 34.55 | 69.50 | 21.69 |
| C | 158 | Roeburn | 25.23 | T084 | 4.80 | 25.35 | 40.30 | 12.87 |
| | | | | T085 | 3.30 | 22.67 | 57.10 | 24.41 |

APPENDIX 9. 1+ TROUT DATA FROM THE RIVER LUNE, 1981-1985.

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| T181 | 401.793 | 6 | 379.934 | 37 | 6.521 | 0.000 |
| T182 | 3091.520 | 6 | 766.970 | 63 | 42.324 | 0.000 |
| T183 | 1998.514 | 6 | 533.255 | 67 | 41.850 | 0.000 |
| T184 | 8412.830 | 6 | 648.601 | 63 | 136.193 | 0.000 |
| T185 | 2941.671 | 6 | 461.593 | 56 | 59.480 | 0.000 |

CLUSTER NUMBER: 1

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| D | 17 | Tebay | 0.30 |
| D | 18 | Old Tebay | 0.81 |
| D | 19 | Rayne Br | 0.70 |
| D | 20 | Kelleth Br | 3.61 |
| D | 21 | Wath | 3.32 |
| C | 103 | Bowderdale | 5.96 |
| D | 106 | Rais B | 3.58 |
| D | 107 | Tebay Gill | 2.30 |
| E | 11 | Lane Ends | 1.21 |
| D | 11a | Park Wood | 1.24 |
| D | 12 | Lincoln Inn | 1.29 |
| D | 13 | Thwaites | 1.84 |
| D | 14 | Fleetholme | 1.35 |
| D | 15 | Fairmile | 1.13 |
| D | 16 | Yorkshire Br | 1.66 |
| D | 6 | K Lonsdale | 1.32 |
| E | 7 | Linderlay | 1.40 |
| E | 8 | Rigmaden | 1.42 |
| D | 9 | Middleton | 1.37 |
| D | 10 | Hallbeck | 1.35 |
| D | 1 | Caton | 1.32 |
| E | 2 | Snab | 1.40 |
| E | 3 | Gressingham | 1.27 |
| D | 4 | Newton | 1.21 |
| D | 5 | Whittington | 1.37 |
| D | 109 | Birk B | 1.29 |
| D | 110 | Birk B | 1.19 |
| D | 117 | Ingmire | 1.30 |
| D | 118 | Sedbergh | 2.63 |
| D | 119a | Cautley | 2.98 |
| D | 120 | Rawthey | 2.47 |
| D | 121 | Clough | 2.22 |
| D | 124 | Dee | 1.14 |
| D | 125 | Dee | 1.93 |
| D | 126 | Dee | 2.49 |
| D | 128 | Barbon B | 1.16 |
| D | 129 | Barbon B | 0.84 |
| D | 133 | Greta | 1.62 |
| D | 134 | Greta | 1.18 |
| D | 135 | Greta | 1.03 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| T181 | 0.00 | 1.19 | 14.00 | 2.62 |
| T182 | 0.00 | 1.21 | 10.70 | 2.51 |
| T183 | 0.00 | 1.14 | 6.20 | 1.57 |
| T184 | 0.00 | 1.81 | 9.40 | 2.16 |
| T185 | 0.00 | 1.50 | 5.40 | 1.69 |

Appendix 9. (Cont.)

| | | | |
|---|---|---|---|
| D | 137 | Doe | 0.89 |
| D | 137a | Doe | 0.06 |
| D | 139 | Wenning | 1.04 |
| D | 140 | Wenning | 0.81 |
| D | 142 | Wenning | 0.98 |
| D | 145 | Wenning | 4.55 |
| D | 146 | Wenning | 1.12 |
| D | 150 | Austwick B | 1.01 |
| D | 152 | Fen B | 4.13 |

CLUSTER NUMBER: 2

| MEMBERS | | | | STATISTICS | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C | 101 Weasdale | 3.07 | T181 | 2.60 | 7.85 | 16.40 | 5.19 |
| C | 104 Longdale B | 4.45 | T182 | 0.60 | 7.46 | 13.90 | 3.96 |
| B | 105 Ellergill | 5.09 | T183 | 0.00 | 6.82 | 15.20 | 3.50 |
| C | 108 Chapel B | 3.78 | T184 | 0.90 | 10.25 | 17.20 | 4.31 |
| C | 111 Birk B | 3.02 | T185 | 0.00 | 3.47 | 15.90 | 4.21 |
| D | 112 Bretherdale | 5.02 | | | | | |
| D | 113 Borrow B | 1.82 | | | | | |
| C | 114 Borrow B | 2.47 | | | | | |
| C | 119 Burnt Mill | 2.58 | | | | | |
| D | 131 Leck B | 5.13 | | | | | |
| C | 132 Leck B | 6.60 | | | | | |
| C | 136 Greta | 4.73 | | | | | |
| B | 138 Greta | 7.26 | | | | | |
| D | 143 Wenning | 3.07 | | | | | |
| C | 151 Austwick B | 1.75 | | | | | |
| C | 151B Austwick B | 1.42 | | | | | |
| C | 153 Keasden B | 3.55 | | | | | |
| D | 154 Hindburn | 2.76 | | | | | |
| C | 157 Roeburn | 2.29 | | | | | |

CLUSTER NUMBER: 3

| MEMBERS | | | | STATISTICS | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A | 116 Crosdale B | 0.00 | T181 | 3.20 | 3.20 | 3.20 | 0.00 |
| | | | T182 | 10.00 | 10.00 | 10.00 | 0.00 |
| | | | T183 | 20.60 | 20.60 | 20.60 | 0.00 |
| | | | T184 | 35.00 | 35.00 | 35.00 | 0.00 |
| | | | T185 | 53.30 | 53.30 | 53.30 | 0.00 |

CLUSTER NUMBER: 4

| MEMBERS | | | | STATISTICS | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B | 122 Clough | 0.00 | T181 | 4.50 | 4.50 | 4.50 | 0.00 |
| | | | T182 | 30.90 | 30.90 | 30.90 | 0.00 |

Appendix 9. (Cont.)

| | | | | |
|---|---|---|---|---|
| T183 | 23.30 | 23.30 | 23.30 | 0.00 |
| T184 | 39.10 | 39.10 | 39.10 | 0.00 |
| T185 | 5.30 | 5.30 | 5.30 | 0.00 |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B 115 | Chapel B | 6.02 | T181 | 4.60 | 7.90 | 13.70 | 3.52 |
| B 127 | Dee | 3.21 | T182 | 1.30 | 9.64 | 18.10 | 5.52 |
| C 130 | Barbon B | 5.97 | T183 | 4.10 | 14.06 | 19.90 | 5.88 |
| C 148 | Clapham B | 2.10 | T184 | 23.00 | 29.38 | 34.90 | 4.70 |
| B 156 | Hindburn | 5.48 | T185 | 7.20 | 13.23 | 18.50 | 4.64 |

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C 102 | Bowderdale | 3.77 | T181 | 9.10 | 10.25 | 11.40 | 1.15 |
| B 144 | Wenning | 3.47 | T182 | 21.30 | 25.43 | 33.30 | 5.56 |
| B 155 | Hindburn | 2.53 | T183 | 6.50 | 10.55 | 13.40 | 2.80 |
| B 158 | Roeburn | 3.81 | T184 | 12.30 | 16.53 | 21.60 | 3.48 |
| | | | T185 | 3.00 | 5.77 | 9.20 | 2.23 |

CLUSTER NUMBER: 7

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A 123 | Clough | 0.00 | T181 | 3.20 | 3.20 | 3.20 | 0.00 |
| | | | T182 | 23.00 | 23.00 | 23.00 | 0.00 |
| | | | T183 | 18.30 | 18.30 | 18.30 | 0.00 |
| | | | T184 | 61.90 | 61.90 | 61.90 | 0.00 |
| | | | T185 | 0.00 | 0.00 | 0.00 | 0.00 |

APPENDIX 10. 0+ AND 1+ SALMON DATA FROM THE RIVER LUNE, 1981-1985

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| S081 | 2004.630 | 6 | 5151.399 | 34 | 2.205 | 0.067 |
| S082 | 122452.720 | 6 | 26604.460 | 64 | 49.096 | 0.000 |
| S083 | 270092.346 | 6 | 16444.073 | 64 | 175.199 | 0.000 |
| S084 | 92419.964 | 6 | 17230.708 | 61 | 54.531 | 0.000 |
| S085 | 54908.405 | 6 | 25953.821 | 54 | 19.041 | 0.000 |
| S181 | 1433.164 | 6 | 1147.766 | 41 | 8.532 | 0.000 |
| S182 | 909.498 | 6 | 1588.550 | 64 | 6.107 | 0.000 |
| S183 | 4538.596 | 6 | 4396.486 | 66 | 11.356 | 0.000 |
| S184 | 6047.585 | 6 | 8973.375 | 67 | 7.526 | 0.000 |
| S185 | 1097.469 | 6 | 1484.641 | 62 | 7.639 | 0.000 |

CLUSTER NUMBER: 1

MEMBERS

| CLASS 0+ | CLASS 1+ | SITE | | DISTANCE |
|---|---|---|---|---|
| D | B | 101 | Weasdale | 14.12 |
| D | B | 102 | Bowderdale | 14.80 |
| D | B | 104 | Longdale B | 20.66 |
| D | B | 105 | Ellergill | 18.37 |
| D | C | 106 | Rais B | 6.94 |
| D | C | 108 | Chapel B | 6.62 |
| D | D | 11 | Lane Ends | 4.20 |
| D | C | 12 | Lincoln Inn | 5.21 |
| D | C | 13 | Thwaites | 9.03 |
| D | D | 14 | Fleetholme | 5.53 |
| D | D | 15 | Fairmile | 4.15 |
| D | B | 16 | Yorkshire Br | 10.03 |
| D | D | 8 | Rigmaden | 3.19 |
| D | D | 9 | Middleton | 5.23 |
| D | D | 10 | Hallbeck | 4.29 |
| D | D | 1 | Caton | 9.63 |
| D | D | 2 | Snab | 4.86 |
| D | E | 3 | Gressingham | 19.07 |
| D | D | 5 | Whittington | 13.42 |
| D | C | 110 | Birk B | 5.78 |
| D | B | 111 | Birk B | 13.22 |
| D | C | 119 | Burnt Mill | 8.25 |
| D | D | 120 | Rawthey | 6.28 |
| D | C | 121 | Clough | 7.17 |
| D | D | 122 | Clough | 6.46 |
| D | D | 123 | Clough | 8.70 |
| D | C | 124 | Dee | 8.05 |
| D | C | 127 | Dee | 3.68 |
| D | B | 132 | Leck B | 12.17 |
| D | D | 134 | Greta | 6.90 |
| D | B | 135 | Greta | 15.68 |
| D | B | 136 | Greta | 7.55 |
| E | E | 137 | Doe | 7.17 |
| E | E | 137a | Doe | 7.72 |
| E | D | 138 | Greta | 7.51 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S081 | 0.00 | 1.54 | 12.30 | 2.87 |
| S082 | 0.00 | 11.54 | 43.90 | 11.51 |
| S083 | 0.00 | 9.73 | 57.10 | 13.93 |
| S084 | 0.00 | 5.96 | 33.90 | 8.27 |
| S085 | 0.00 | 5.91 | 39.90 | 9.09 |
| S181 | 0.00 | 4.45 | 19.80 | 5.48 |
| S182 | 0.00 | 3.09 | 22.60 | 4.45 |
| S183 | 0.00 | 4.96 | 44.60 | 8.26 |
| S184 | 0.00 | 8.50 | 61.60 | 11.87 |
| S185 | 0.00 | 2.61 | 14.20 | 3.74 |

Appendix 10. (Cont.)

| | | | | |
|---|---|---|---|---|
| D | D 139 | Wenning | 11.41 | |
| D | D 140 | Wenning | 5.00 | |
| D | E 141 | Wenning | 5.56 | |
| E | D 142 | Wenning | 7.14 | |
| E | D 143 | Wenning | 7.03 | |
| D | D 144 | Wenning | 6.34 | |
| D | D 145 | Wenning | 3.04 | |
| D | D 148 | Clapham B | 3.47 | |
| D | D 150 | Austwick B | 4.92 | |
| D | D 151 | Austwick B | 9.46 | |
| D | D 151b | Austwick B | 7.26 | |
| D | E 152 | Fen B | 5.82 | |
| E | E 153 | Keasden B | 7.17 | |
| D | D 154 | Hindburn | 6.95 | |
| E | E 155 | Hindburn | 6.58 | |
| E | E 156 | Hindburn | 6.58 | |
| D | D 157 | Roeburn | 7.11 | |
| E | D 158 | Roeburn | 6.54 | |

CLUSTER NUMBER: 2

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A A 107 | Tebay Gill | 0.00 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S082 | 43.70 | 43.70 | 43.70 | 0.00 |
| | | | S083 | 505.60 | 505.60 | 505.60 | 0.00 |
| | | | S084 | 113.10 | 113.10 | 113.10 | 0.00 |
| | | | S085 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S182 | 7.50 | 7.50 | 7.50 | 0.00 |
| | | | S183 | 70.20 | 70.20 | 70.20 | 0.00 |
| | | | S184 | 61.60 | 61.60 | 61.60 | 0.00 |
| | | | S185 | 0.00 | 0.00 | 0.00 | 0.00 |

CLUSTER NUMBER: 3

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B C 128 | Barbon B | 0.00 | S081 | 15.00 | 15.00 | 15.00 | 0.00 |
| | | | S082 | 223.20 | 223.20 | 223.20 | 0.00 |
| | | | S083 | 69.70 | 69.70 | 69.70 | 0.00 |
| | | | S084 | 279.90 | 279.90 | 279.90 | 0.00 |
| | | | S085 | 152.90 | 152.90 | 152.90 | 0.00 |
| | | | S181 | 5.50 | 5.50 | 5.50 | 0.00 |
| | | | S182 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S183 | 5.40 | 5.40 | 5.40 | 0.00 |
| | | | S184 | 9.40 | 9.40 | 9.40 | 0.00 |
| | | | S185 | 6.10 | 6.10 | 6.10 | 0.00 |

Appendix 10. (Cont.)

CLUSTER NUMBER: 4

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B B 116 | Crosdale B | 4.72 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| D B 130 | Barbon B | 4.42 | S082 | 251.30 | 251.30 | 251.30 | 0.00 |
| | | | S083 | 55.10 | 55.10 | 55.10 | 0.00 |
| | | | S084 | 0.00 | 1.45 | 2.90 | 1.45 |
| | | | S085 | 0.00 | 1.70 | 3.40 | 1.70 |
| | | | S181 | 21.30 | 21.30 | 21.30 | 0.00 |
| | | | S182 | 13.30 | 23.60 | 33.90 | 10.30 |
| | | | S183 | 14.90 | 15.65 | 16.40 | 0.75 |
| | | | S184 | 38.40 | 44.25 | 50.10 | 5.85 |
| | | | S185 | 9.50 | 12.70 | 15.90 | 3.20 |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B C 103 | Bowderdale | 0.00 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S082 | 33.90 | 33.90 | 33.90 | 0.00 |
| | | | S083 | 143.40 | 143.40 | 143.40 | 0.00 |
| | | | S084 | 2.00 | 2.00 | 2.00 | 0.00 |
| | | | S085 | 152.60 | 152.60 | 152.60 | 0.00 |
| | | | S181 | 25.10 | 25.10 | 25.10 | 0.00 |
| | | | S182 | 1.10 | 1.10 | 1.10 | 0.00 |
| | | | S183 | 4.70 | 4.70 | 4.70 | 0.00 |
| | | | S184 | 7.50 | 7.50 | 7.50 | 0.00 |
| | | | S185 | 2.90 | 2.90 | 2.90 | 0.00 |

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C D 17 | Tebay | 6.72 | S081 | 0.00 | 17.02 | 64.70 | 21.17 |
| B D 18 | Old Tebay | 13.16 | S082 | 13.20 | 63.44 | 139.60 | 33.45 |
| B C 19 | Rayne Br | 17.83 | S083 | 4.60 | 42.20 | 77.70 | 19.08 |
| C B 20 | Kelleth Br | 11.31 | S084 | 0.00 | 27.23 | 103.50 | 26.14 |
| C C 21 | Wath | 18.44 | S085 | 4.60 | 45.97 | 133.60 | 36.59 |
| D D 11a | Park Wood | 14.66 | S181 | 0.80 | 6.37 | 14.40 | 4.30 |
| D D 6 | K Lonsdale | 20.67 | S182 | 0.00 | 5.71 | 17.40 | 4.86 |
| D D 7 | Linderlay | 14.51 | S183 | 0.00 | 6.36 | 24.20 | 6.59 |
| C D 4 | Newton | 13.61 | S184 | 0.40 | 10.31 | 43.30 | 10.32 |
| C C 109 | Birk B | 26.57 | S185 | 0.00 | 3.76 | 17.10 | 4.47 |
| C C 112 | Bretherdale | 12.03 | | | | | |
| C B 113 | Borrow B | 22.43 | | | | | |
| C B 114 | Borrow B | 18.67 | | | | | |
| C D 117 | Ingmire | 14.00 | | | | | |
| C D 119a | Cautley | 12.14 | | | | | |

Appendix 10. (Cont.)

| | | | | |
|---|---|---|---|---|
| B | D | 125 | Dee | 21.92 |
| D | D | 126 | Dee | 30.34 |
| B | D | 129 | Barbon B | 31.79 |
| D | B | 131 | Leck B | 15.26 |
| D | D | 133 | Greta | 14.47 |
| D | D | 146 | Wenning | 32.04 |

CLUSTER NUMBER: 7

| MEMBERS | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|
| CLASS | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B | B 115 | Chapel B | 12.91 | S081 | 2.20 | 2.20 | 2.20 | 0.00 |
| C | A 118 | Sedbergh | 10.80 | S082 | 11.30 | 22.15 | 33.00 | 10.85 |
| | | | | S083 | 81.50 | 92.95 | 104.40 | 11.45 |
| | | | | S084 | 55.70 | 75.10 | 94.50 | 19.40 |
| | | | | S085 | 29.60 | 34.45 | 39.30 | 4.85 |
| | | | | S181 | 33.80 | 33.80 | 33.80 | 0.00 |
| | | | | S182 | 10.60 | 10.60 | 10.60 | 0.00 |
| | | | | S183 | 2.70 | 16.70 | 30.70 | 14.00 |
| | | | | S184 | 23.50 | 33.05 | 42.60 | 9.55 |
| | | | | S185 | 9.50 | 24.70 | 39.90 | 15.20 |

APPENDIX 11. 0+ AND 1+ TROUT DATA FROM THE RIVER LUNE, 1981-1985

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| T081 | 290.675 | 6 | 351.035 | 32 | 4.416 | 0.002 |
| T082 | 262970.813 | 6 | 12321.587 | 58 | 206.309 | 0.000 |
| T083 | 53180.582 | 6 | 17162.488 | 62 | 32.019 | 0.000 |
| T084 | 199519.543 | 6 | 25996.668 | 61 | 78.027 | 0.000 |
| T085 | 305372.728 | 6 | 15654.268 | 50 | 162.561 | 0.000 |
| T181 | 238.956 | 6 | 542.770 | 37 | 2.715 | 0.028 |
| T182 | 968.883 | 6 | 2889.607 | 63 | 3.521 | 0.005 |
| T183 | 1124.125 | 6 | 1407.644 | 67 | 8.918 | 0.000 |
| T184 | 4974.606 | 6 | 4086.826 | 63 | 12.781 | 0.000 |
| T185 | 2590.943 | 6 | 812.321 | 56 | 29.769 | 0.000 |

CLUSTER NUMBER: 1

MEMBERS

| CLASS 0+ | CLASS 1+ | | SITE | DISTANCE |
|---|---|---|---|---|
| D | D | 17 | Tebay | 4.75 |
| D | D | 18 | Old Tebay | 3.55 |
| C | D | 20 | Kelleth Br | 11.67 |
| D | D | 106 | Rais B | 5.85 |
| D | D | 12 | Lincoln Inn | 3.18 |
| D | D | 14 | Fleetholme | 5.94 |
| D | D | 16 | Yorkshire Br | 5.75 |
| D | D | 6 | K Lonsdale | 6.10 |
| D | E | 7 | Linderlay | 6.45 |
| D | E | 8 | Rigmaden | 7.53 |
| D | D | 9 | Middleton | 6.44 |
| D | D | 10 | Hallbeck | 6.42 |
| E | D | 1 | Caton | 5.29 |
| E | E | 2 | Snab | 6.47 |
| D | E | 3 | Gressingham | 6.56 |
| D | D | 4 | Newton | 6.13 |
| E | D | 5 | Whittington | 5.32 |
| D | D | 109 | Birk B | 7.76 |
| D | D | 110 | Birk B | 12.77 |
| D | C | 111 | Birk B | 5.27 |
| D | D | 113 | Borrow B | 11.14 |
| C | C | 114 | Borrow B | 15.91 |
| D | D | 117 | Ingmire | 5.96 |
| D | C | 119 | Burnt Mill | 3.97 |
| D | D | 119a | Cautley | 3.20 |
| D | D | 120 | Rawthey | 10.41 |
| D | D | 121 | Clough | 12.02 |
| D | D | 125 | Dee | 7.85 |
| D | D | 126 | Dee | 6.89 |
| D | D | 128 | Barbon B | 8.64 |
| D | D | 129 | Barbon B | 8.40 |
| D | C | 130 | Barbon B | 10.61 |
| D | D | 131 | Leck B | 5.44 |
| D | D | 133 | Greta | 5.87 |
| D | D | 134 | Greta | 5.72 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| T081 | 0.00 | 0.88 | 5.50 | 1.73 |
| T082 | 0.00 | 9.44 | 48.00 | 11.84 |
| T083 | 0.00 | 12.79 | 96.20 | 16.16 |
| T084 | 0.00 | 8.72 | 41.80 | 12.51 |
| T085 | 0.00 | 5.13 | 36.50 | 7.98 |
| T181 | 0.00 | 1.92 | 13.70 | 3.36 |
| T182 | 0.00 | 3.78 | 21.70 | 5.88 |
| T183 | 0.00 | 3.03 | 16.50 | 3.84 |
| T184 | 0.00 | 5.45 | 34.90 | 7.44 |
| T185 | 0.00 | 2.39 | 18.50 | 3.82 |

Appendix 11. (Cont.)

| | | | | |
|---|---|---|---|---|
| D | D | 135 | Greta | 4.61 |
| C | C | 136 | Greta | 30.59 |
| D | D | 137 | Doe | 5.61 |
| D | B | 138 | Greta | 6.30 |
| D | D | 139 | Wenning | 6.55 |
| D | D | 140 | Wenning | 5.88 |
| D | D | 142 | Wenning | 5.31 |
| D | D | 143 | Wenning | 5.85 |
| D | B | 144 | Wenning | 8.61 |
| D | D | 145 | Wenning | 4.64 |
| D | D | 146 | Wenning | 11.75 |
| D | C | 151b | Austwick B | 1.67 |
| D | D | 152 | Fen B | 10.18 |
| D | C | 153 | Keasden B | 7.25 |
| D | D | 154 | Hindburn | 4.07 |
| D | B | 155 | Hindburn | 11.45 |
| D | B | 156 | Hindburn | 20.54 |
| D | C | 157 | Roeburn | 9.03 |

CLUSTER NUMBER: 2

| MEMBERS | | | | STATISTICS | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A A 116 | Crosdale B | 0.00 | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 502.10 | 502.10 | 502.10 | 0.00 |
| | | | T083 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T084 | 349.80 | 349.80 | 349.80 | 0.00 |
| | | | T085 | 432.20 | 432.20 | 432.20 | 0.00 |
| | | | T181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T182 | 10.00 | 10.00 | 10.00 | 0.00 |
| | | | T183 | 20.60 | 20.60 | 20.60 | 0.00 |
| | | | T184 | 35.00 | 35.00 | 35.00 | 0.00 |
| | | | T185 | 53.30 | 53.30 | 53.30 | 0.00 |

CLUSTER NUMBER: 3

| MEMBERS | | | | STATISTICS | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D D 19 | Rayne Br | 3.99 | T081 | 0.00 | 0.63 | 2.50 | 1.08 |
| B D 107 | Tebay Gill | 2.46 | T082 | 0.00 | 1.24 | 5.90 | 2.33 |
| D E 11 | Lane Ends | 0.70 | T083 | 0.00 | 4.01 | 8.70 | 3.48 |
| D D 11a | Park Wood | 1.90 | T084 | 0.10 | 6.60 | 15.50 | 5.62 |
| D D 13 | Thwaites | 1.45 | T085 | 361.20 | 361.20 | 361.20 | 0.00 |
| D D 15 | Fairmile | 2.59 | T181 | 0.00 | 0.73 | 2.20 | 1.04 |
| D D 118 | Sedbergh | 2.79 | T182 | 0.00 | 0.33 | 1.10 | 0.42 |
| D D 124 | Dee | 2.29 | T183 | 0.00 | 1.23 | 6.20 | 2.09 |
| E D 137a | Doe | 2.84 | T184 | 0.00 | 1.23 | 3.40 | 1.28 |
| E E 141 | Wenning | 1.24 | T185 | 0.00 | 2.70 | 5.40 | 1.94 |

Appendix 11. (Cont.)

CLUSTER NUMBER: 4

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A C 101 | Weasdale | 10.76 | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| B B 105 | Ellergill | 13.61 | T082 | 45.30 | 73.95 | 102.60 | 28.65 |
| | | | T083 | 76.50 | 85.25 | 94.00 | 8.75 |
| | | | T084 | 245.80 | 245.80 | 245.80 | 0.00 |
| | | | T085 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T182 | 8.10 | 9.60 | 11.10 | 1.50 |
| | | | T183 | 5.00 | 10.10 | 15.20 | 5.10 |
| | | | T184 | 12.90 | 13.55 | 14.20 | 0.65 |
| | | | T185 | 1.10 | 1.10 | 1.10 | 0.00 |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A C 151 | Austwick B | 0.00 | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 116.20 | 116.20 | 116.20 | 0.00 |
| | | | T083 | 203.40 | 203.40 | 203.40 | 0.00 |
| | | | T084 | 73.40 | 73.40 | 73.40 | 0.00 |
| | | | T085 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T182 | 6.40 | 6.40 | 6.40 | 0.00 |
| | | | T183 | 7.60 | 7.60 | 7.60 | 0.00 |
| | | | T184 | 8.40 | 8.40 | 8.40 | 0.00 |
| | | | T185 | 0.80 | 0.80 | 0.80 | 0.00 |

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C D 21 | Wath | 21.32 | T081 | 1.00 | 8.00 | 19.70 | 6.61 |
| C C 102 | Bowderdale | 26.29 | T082 | 0.00 | 34.09 | 79.20 | 19.14 |
| C C 103 | Bowderdale | 13.16 | T083 | 15.90 | 47.04 | 77.80 | 22.07 |
| C C 104 | Longdale B | 3.16 | T084 | 4.80 | 75.42 | 127.90 | 39.25 |
| C C 108 | Chapel B | 32.34 | T085 | 8.00 | 55.59 | 116.90 | 37.79 |
| C D 112 | Bretherdale | 12.88 | T181 | 2.60 | 7.82 | 16.40 | 4.72 |
| B B 115 | Chapel B | 20.54 | T182 | 0.60 | 10.44 | 33.30 | 10.39 |
| C B 122 | Clough | 25.43 | T183 | 1.90 | 10.68 | 23.30 | 7.22 |
| C B 127 | Dee | 15.29 | T184 | 0.70 | 15.71 | 39.10 | 11.58 |
| C C 132 | Leck B | 16.44 | T185 | 0.00 | 5.55 | 14.00 | 3.83 |
| D C 148 | Clapham B | 13.24 | | | | | |
| C D 150 | Austwick B | 23.23 | | | | | |
| C B 158 | Roeburn | 28.46 | | | | | |

Appendix 11. (Cont.)

CLUSTER NUMBER: 7

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D A 123 | Clough | 0.00 | T081 | 7.70 | 7.70 | 7.70 | 0.00 |
| | | | T082 | 116.30 | 116.30 | 116.30 | 0.00 |
| | | | T083 | 18.50 | 18.50 | 18.50 | 0.00 |
| | | | T084 | 27.50 | 27.50 | 27.50 | 0.00 |
| | | | T085 | 7.60 | 7.60 | 7.60 | 0.00 |
| | | | T181 | 3.20 | 3.20 | 3.20 | 0.00 |
| | | | T182 | 23.00 | 23.00 | 23.00 | 0.00 |
| | | | T183 | 18.30 | 18.30 | 18.30 | 0.00 |
| | | | T184 | 61.90 | 61.90 | 61.90 | 0.00 |
| | | | T185 | 0.00 | 0.00 | 0.00 | 0.00 |

APPENDIX 12. 0+ SALMON (SA) AND 0+ TROUT (TR) DATA FROM THE RIVER LUNE, 1981-1985

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| S081 | 153.221 | 6 | 7002.808 | 34 | 0.124 | 0.993 |
| S082 | 88107.149 | 6 | 60950.031 | 64 | 15.419 | 0.000 |
| S083 | 246048.605 | 6 | 40487.814 | 64 | 64.822 | 0.000 |
| S084 | 79351.155 | 6 | 30299.516 | 61 | 26.625 | 0.000 |
| S085 | 35713.172 | 6 | 45149.053 | 54 | 7.119 | 0.000 |
| T081 | 4.626 | 6 | 637.083 | 32 | 0.039 | 1.000 |
| T082 | 246236.100 | 6 | 29056.300 | 58 | 81.920 | 0.000 |
| T083 | 43370.648 | 6 | 26972.422 | 62 | 16.616 | 0.000 |
| T084 | 159613.749 | 6 | 65902.462 | 61 | 24.623 | 0.000 |
| T085 | 288863.835 | 6 | 32163.161 | 50 | 74.843 | 0.000 |

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CLUSTER NUMBER: 1

MEMBERS

| CLASS SA | CLASS TR | | SITE | DISTANCE |
|---|---|---|---|---|
| C | D | 17 | Tebay | 21.56 |
| B | D | 18 | Old Tebay | 25.36 |
| B | D | 19 | Rayne Br | 30.67 |
| C | C | 20 | Kelleth Br | 23.69 |
| C | C | 21 | Wath | 41.67 |
| D | C | 102 | Bowderdale | 44.63 |
| D | D | 106 | Rais B | 17.19 |
| D | C | 108 | Chapel B | 41.32 |
| D | D | 11 | Lane Ends | 17.76 |
| D | D | 11a | Park Wood | 25.22 |
| D | D | 12 | Lincoln Inn | 7.46 |
| D | D | 13 | Thwaites | 11.08 |
| D | D | 14 | Fleetholme | 17.25 |
| D | D | 15 | Fairmile | 15.94 |
| D | D | 16 | Yorkshire Br | 15.39 |
| D | D | 6 | K Lonsdale | 28.73 |
| D | D | 7 | Linderlay | 17.93 |
| D | D | 8 | Rigmaden | 16.22 |
| D | D | 9 | Middleton | 12.54 |
| D | D | 10 | Hallbeck | 12.36 |
| D | E | 1 | Caton | 11.04 |
| D | E | 2 | Snab | 15.49 |
| D | D | 3 | Gressingham | 17.01 |
| C | D | 4 | Newton | 18.46 |
| D | E | 5 | Whittington | 12.53 |
| C | D | 109 | Birk B | 35.18 |
| D | D | 110 | Birk B | 12.70 |
| D | D | 111 | Birk B | 13.56 |
| C | C | 112 | Bretherdale | 25.15 |
| C | D | 113 | Borrow B | 36.69 |
| C | C | 114 | Borrow B | 24.86 |
| B | B | 115 | Chapel B | 56.11 |
| C | D | 117 | Ingmire | 14.26 |
| C | D | 118 | Sedbergh | 30.91 |
| D | D | 119 | Burnt Mill | 10.56 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S081 | 0.00 | 6.08 | 64.70 | 13.58 |
| S082 | 0.00 | 26.13 | 139.60 | 30.76 |
| S083 | 0.00 | 24.49 | 104.40 | 25.35 |
| S084 | 0.00 | 15.53 | 103.50 | 22.47 |
| S085 | 0.00 | 18.74 | 133.60 | 28.39 |
| T081 | 0.00 | 2.18 | 19.70 | 4.09 |
| T082 | 0.00 | 15.70 | 116.30 | 21.89 |
| T083 | 0.00 | 17.09 | 96.20 | 20.77 |
| T084 | 0.00 | 19.97 | 127.90 | 32.80 |
| T085 | 0.00 | 12.59 | 116.90 | 24.87 |

Appendix 12. (Cont.)

| | | | | |
|---|---|---|---|---|
| C | D | 119a | Cautley | 10.52 |
| D | D | 120 | Rawthey | 10.04 |
| D | D | 121 | Clough | 12.96 |
| D | C | 122 | Clough | 39.79 |
| D | D | 123 | Clough | 33.89 |
| D | D | 124 | Dee | 8.97 |
| B | D | 125 | Dee | 30.04 |
| D | D | 126 | Dee | 41.32 |
| D | C | 127 | Dee | 38.41 |
| B | D | 129 | Barbon B | 45.77 |
| D | D | 130 | Barbon B | 16.73 |
| D | D | 131 | Leck B | 17.60 |
| D | C | 132 | Leck B | 17.32 |
| D | D | 133 | Greta | 15.53 |
| D | D | 134 | Greta | 10.78 |
| D | D | 135 | Greta | 11.07 |
| D | C | 136 | Greta | 30.53 |
| E | D | 137 | Doe | 19.13 |
| E | D | 138 | Greta | 17.70 |
| D | D | 139 | Wenning | 14.38 |
| D | D | 140 | Wenning | 15.45 |
| D | E | 141 | Wenning | 19.02 |
| E | D | 142 | Wenning | 18.51 |
| E | D | 143 | Wenning | 19.24 |
| D | D | 144 | Wenning | 17.06 |
| D | D | 145 | Wenning | 10.16 |
| D | D | 146 | Wenning | 37.54 |
| D | D | 148 | Clapham B | 21.03 |
| D | C | 150 | Austwick B | 50.78 |
| D | D | 152 | Fen B | 17.87 |
| E | D | 153 | Keasden B | 17.25 |
| D | D | 154 | Hindburn | 13.86 |
| E | D | 155 | Hindburn | 16.74 |
| E | D | 156 | Hindburn | 20.31 |
| D | D | 157 | Roeburn | 12.77 |
| E | C | 158 | Roeburn | 33.23 |

CLUSTER NUMBER: 2

MEMBERS

| CLASS | | SITE | DISTANCE |
|---|---|---|---|
| B | A 116 | Crosdale B | 0.00 |
| E | E 137a | Doe | 4.53 |
| D | D 151b | Austwick B | 4.53 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| S082 | 251.30 | 251.30 | 251.30 | 0.00 |
| S083 | 0.00 | 0.15 | 0.30 | 0.15 |
| S084 | 2.90 | 2.90 | 2.90 | 0.00 |
| S085 | 0.00 | 0.00 | 0.00 | 0.00 |
| T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| T082 | 502.10 | 502.10 | 502.10 | 0.00 |
| T083 | 0.00 | 6.40 | 12.80 | 6.40 |
| T084 | 349.80 | 349.80 | 349.80 | 0.00 |
| T085 | 432.20 | 432.20 | 432.20 | 0.00 |

Appendix 12. (Cont.)

CLUSTER NUMBER: 3

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| A B 107 | Tebay Gill | 0.00 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S082 | 43.70 | 43.70 | 43.70 | 0.00 |
| | | | S083 | 505.60 | 505.60 | 505.60 | 0.00 |
| | | | S084 | 113.10 | 113.10 | 113.10 | 0.00 |
| | | | S085 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T083 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T084 | 2.10 | 2.10 | 2.10 | 0.00 |
| | | | T085 | 361.20 | 361.20 | 361.20 | 0.00 |

CLUSTER NUMBER: 4

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B D 128 | Barbon B | 0.00 | S081 | 15.00 | 15.00 | 15.00 | 0.00 |
| | | | S082 | 223.20 | 223.20 | 223.20 | 0.00 |
| | | | S083 | 69.70 | 69.70 | 69.70 | 0.00 |
| | | | S084 | 279.90 | 279.90 | 279.90 | 0.00 |
| | | | S085 | 152.90 | 152.90 | 152.90 | 0.00 |
| | | | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 14.70 | 14.70 | 14.70 | 0.00 |
| | | | T083 | 15.20 | 15.20 | 15.20 | 0.00 |
| | | | T084 | 32.10 | 32.10 | 32.10 | 0.00 |
| | | | T085 | 15.80 | 15.80 | 15.80 | 0.00 |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D A 101 | Weasdale | 10.63 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| D B 105 | Ellergill | 15.04 | S082 | 43.90 | 43.90 | 43.90 | 0.00 |
| | | | S083 | 0.00 | 2.50 | 5.00 | 2.50 |
| | | | S084 | 1.90 | 2.90 | 3.90 | 1.00 |
| | | | S085 | 1.10 | 1.10 | 1.10 | 0.00 |
| | | | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 45.30 | 73.95 | 102.60 | 28.65 |
| | | | T083 | 76.50 | 85.25 | 94.00 | 8.75 |
| | | | T084 | 245.80 | 245.80 | 245.80 | 0.00 |
| | | | T085 | 0.00 | 0.00 | 0.00 | 0.00 |

Appendix 12. (Cont.)

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D A 151 | Austwick B | 0.00 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S082 | 5.60 | 5.60 | 5.60 | 0.00 |
| | | | S083 | 7.60 | 7.60 | 7.60 | 0.00 |
| | | | S084 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S085 | 27.80 | 27.80 | 27.80 | 0.00 |
| | | | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 116.20 | 116.20 | 116.20 | 0.00 |
| | | | T083 | 203.40 | 203.40 | 203.40 | 0.00 |
| | | | T084 | 73.40 | 73.40 | 73.40 | 0.00 |
| | | | T085 | 0.00 | 0.00 | 0.00 | 0.00 |

CLUSTER NUMBER: 7

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B C 103 | Bowderdale | 6.93 | S081 | 0.00 | 0.00 | 0.00 | 0.00 |
| D C 104 | Longdale B | 8.76 | S082 | 6.40 | 20.15 | 33.90 | 13.75 |
| | | | S083 | 143.40 | 143.40 | 143.40 | 0.00 |
| | | | S084 | 1.40 | 1.70 | 2.00 | 0.30 |
| | | | S085 | 152.60 | 152.60 | 152.60 | 0.00 |
| | | | T081 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T082 | 18.90 | 26.35 | 33.80 | 7.45 |
| | | | T083 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T084 | 49.60 | 61.40 | 73.20 | 11.80 |
| | | | T085 | 63.50 | 63.50 | 63.50 | 0.00 |

APPENDIX 13. 1+ SALMON (SA) AND 1+ TROUT (TR) DATA FROM THE RIVER LUNE, 1981-1985

SUMMARY STATISTICS FOR 7 CLUSTERS

| VARIABLE | BETWEEN SS | DF | WITHIN SS | DF | F-RATIO | PROB |
|---|---|---|---|---|---|---|
| S181 | 1293.046 | 6 | 1287.884 | 41 | 6.861 | 0.000 |
| S182 | 899.369 | 6 | 1598.679 | 64 | 6.001 | 0.000 |
| S183 | 7109.325 | 6 | 1825.757 | 66 | 42.833 | 0.000 |
| S184 | 11793.147 | 6 | 3227.812 | 67 | 40.799 | 0.000 |
| S185 | 1847.611 | 6 | 734.499 | 62 | 25.993 | 0.000 |
| T181 | 233.670 | 6 | 548.056 | 37 | 2.629 | 0.032 |
| T182 | 2460.723 | 6 | 1397.767 | 63 | 18.485 | 0.000 |
| T183 | 1830.841 | 6 | 700.928 | 67 | 29.168 | 0.000 |
| T184 | 5491.696 | 6 | 3569.736 | 63 | 16.153 | 0.000 |
| T185 | 2843.762 | 6 | 559.502 | 56 | 47.438 | 0.000 |

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CLUSTER NUMBER: 1

MEMBERS

| CLASS SA | CLASS TR | | SITE | DISTANCE |
|---|---|---|---|---|
| D | D | 17 | Tebay | 1.47 |
| D | D | 18 | Old Tebay | 2.24 |
| C | D | 21 | Wath | 5.26 |
| C | C | 103 | Bowderdale | 7.76 |
| C | D | 106 | Rais B | 4.59 |
| C | C | 108 | Chapel B | 5.31 |
| D | D | 11a | Park Wood | 1.99 |
| C | D | 12 | Lincoln Inn | 5.37 |
| C | D | 13 | Thwaites | 4.19 |
| D | D | 14 | Fleetholme | 2.00 |
| D | D | 15 | Fairmile | 1.67 |
| D | D | 6 | K Lonsdale | 1.80 |
| D | E | 7 | Linderlay | 2.79 |
| D | E | 8 | Rigmaden | 2.17 |
| D | D | 9 | Middleton | 2.18 |
| D | D | 10 | Hallbeck | 2.78 |
| D | D | 1 | Caton | 2.63 |
| D | E | 2 | Snab | 3.08 |
| E | E | 3 | Gressingham | 2.30 |
| D | D | 4 | Newton | 1.95 |
| D | D | 5 | Whittington | 2.80 |
| C | D | 109 | Birk B | 2.98 |
| C | D | 110 | Birk B | 4.19 |
| C | D | 112 | Bretherdale | 6.12 |
| D | D | 117 | Ingmire | 1.92 |
| C | C | 119 | Burnt Mill | 5.16 |
| D | D | 119a | Cautley | 1.81 |
| D | D | 120 | Rawthey | 2.88 |
| C | D | 121 | Clough | 1.54 |
| C | D | 124 | Dee | 4.79 |
| D | D | 125 | Dee | 2.15 |
| D | D | 126 | Dee | 2.73 |
| C | D | 128 | Barbon B | 2.52 |
| D | D | 133 | Greta | 4.53 |
| D | D | 134 | Greta | 3.27 |

STATISTICS

| VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
|---|---|---|---|---|
| S181 | 0.00 | 4.60 | 25.10 | 4.91 |
| S182 | 0.00 | 2.71 | 17.40 | 3.73 |
| S183 | 0.00 | 2.87 | 13.80 | 3.11 |
| S184 | 0.00 | 5.55 | 20.30 | 5.42 |
| S185 | 0.00 | 2.09 | 12.40 | 2.58 |
| T181 | 0.00 | 1.53 | 14.00 | 2.98 |
| T182 | 0.00 | 2.59 | 13.90 | 3.99 |
| T183 | 0.00 | 2.23 | 11.70 | 2.82 |
| T184 | 0.00 | 2.67 | 10.00 | 3.16 |
| T185 | 0.00 | 1.73 | 15.90 | 2.71 |

Appendix 13. (Cont.)

| | | | | |
|---|---|---|---|---|
| E | D | 137 | Doe | 2.83 |
| E | D | 137a | Doe | 2.15 |
| D | B | 138 | Greta | 6.95 |
| D | D | 139 | Wenning | 3.45 |
| D | D | 140 | Wenning | 2.36 |
| D | D | 142 | Wenning | 2.55 |
| D | D | 143 | Wenning | 4.19 |
| D | D | 145 | Wenning | 3.20 |
| D | D | 146 | Wenning | 2.52 |
| D | D | 150 | Austwick B | 1.42 |
| D | C | 151 | Austwick B | 3.83 |
| D | C | 151b | Austwick B | 2.64 |
| E | D | 152 | Fen B | 3.66 |
| E | C | 153 | Keasden B | 5.45 |
| D | D | 154 | Hindburn | 3.29 |
| D | C | 157 | Roeburn | 4.72 |

CLUSTER NUMBER: 2

| MEMBERS | | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CLASS | | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| C | D | 19 | Rayne Br | 5.25 | S181 | 8.50 | 17.37 | 33.80 | 7.38 |
| B | D | 20 | Kelleth Br | 5.24 | S182 | 1.20 | 10.55 | 33.90 | 8.09 |
| B | C | 101 | Weasdale | 8.44 | S183 | 0.90 | 13.85 | 31.40 | 9.33 |
| B | C | 102 | Bowderdale | 4.68 | S184 | 7.40 | 24.81 | 43.30 | 11.09 |
| B | D | 16 | Yorkshire Br | 6.39 | S185 | 1.10 | 8.51 | 17.10 | 5.52 |
| B | C | 111 | Birk B | 7.99 | T181 | 0.00 | 4.45 | 16.40 | 5.64 |
| B | D | 113 | Borrow B | 5.63 | T182 | 0.00 | 4.12 | 13.40 | 4.23 |
| B | C | 114 | Borrow B | 5.89 | T183 | 0.00 | 4.23 | 10.50 | 3.43 |
| A | D | 118 | Sedbergh | 9.73 | T184 | 2.00 | 10.81 | 34.90 | 8.86 |
| C | D | 129 | Barbon B | 5.37 | T185 | 0.00 | 3.36 | 10.60 | 2.94 |
| B | C | 130 | Barbon B | 11.86 | | | | | |
| B | D | 131 | Leck B | 7.64 | | | | | |
| B | C | 132 | Leck B | 7.43 | | | | | |
| B | D | 135 | Greta | 6.49 | | | | | |
| B | C | 136 | Greta | 5.90 | | | | | |

CLUSTER NUMBER: 3

| MEMBERS | | | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CLASS | | | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D | B | 122 | Clough | 5.55 | S181 | 0.00 | 1.81 | 10.90 | 3.63 |
| D | A | 123 | Clough | 11.73 | S182 | 0.00 | 1.35 | 5.50 | 2.03 |
| C | B | 127 | Dee | 5.56 | S183 | 0.00 | 3.34 | 8.90 | 3.08 |
| D | B | 144 | Wenning | 6.17 | S184 | 0.00 | 1.41 | 5.20 | 2.00 |
| D | C | 148 | Clapham B | 4.31 | S185 | 0.00 | 0.43 | 1.30 | 0.61 |
| E | B | 155 | Hindburn | 5.34 | T181 | 3.20 | 7.73 | 13.70 | 3.62 |
| E | B | 156 | Hindburn | 4.24 | T182 | 10.50 | 21.27 | 33.30 | 7.62 |
| D | B | 158 | Roeburn | 5.56 | T183 | 9.40 | 15.45 | 23.30 | 4.34 |
| | | | | | T184 | 12.30 | 29.30 | 61.90 | 16.12 |
| | | | | | T185 | 3.00 | 8.36 | 18.50 | 5.44 |

Appendix 13. (Cont.)

CLUSTER NUMBER: 4

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B C 104 | Longdale B | 3.16 | S181 | 14.20 | 14.20 | 14.20 | 0.00 |
| A D 107 | Tebay Gill | 3.37 | S182 | 7.50 | 7.70 | 7.90 | 0.20 |
| | | | S183 | 70.20 | 70.20 | 70.20 | 0.00 |
| | | | S184 | 61.60 | 61.60 | 61.60 | 0.00 |
| | | | S185 | 3.80 | 3.80 | 3.80 | 0.00 |
| | | | T181 | 2.60 | 2.60 | 2.60 | 0.00 |
| | | | T182 | 0.00 | 2.70 | 5.40 | 2.70 |
| | | | T183 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T184 | 0.00 | 8.50 | 17.00 | 8.50 |
| | | | T185 | 4.80 | 5.10 | 5.40 | 0.30 |

CLUSTER NUMBER: 5

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B A 116 | Crosdale B | 0.00 | S181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S182 | 13.30 | 13.30 | 13.30 | 0.00 |
| | | | S183 | 16.40 | 16.40 | 16.40 | 0.00 |
| | | | S184 | 50.10 | 50.10 | 50.10 | 0.00 |
| | | | S185 | 9.50 | 9.50 | 9.50 | 0.00 |
| | | | T181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T182 | 10.00 | 10.00 | 10.00 | 0.00 |
| | | | T183 | 20.60 | 20.60 | 20.60 | 0.00 |
| | | | T184 | 35.00 | 35.00 | 35.00 | 0.00 |
| | | | T185 | 53.30 | 53.30 | 53.30 | 0.00 |

CLUSTER NUMBER: 6

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| B B 105 | Ellergill | 0.00 | S181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | S182 | 5.60 | 5.60 | 5.60 | 0.00 |
| | | | S183 | 44.60 | 44.60 | 44.60 | 0.00 |
| | | | S184 | 5.20 | 5.20 | 5.20 | 0.00 |
| | | | S185 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T182 | 8.10 | 8.10 | 8.10 | 0.00 |
| | | | T183 | 15.20 | 15.20 | 15.20 | 0.00 |
| | | | T184 | 12.90 | 12.90 | 12.90 | 0.00 |
| | | | T185 | 0.00 | 0.00 | 0.00 | 0.00 |

Appendix 13. (Cont.)

CLUSTER NUMBER: 7

| MEMBERS | | | STATISTICS | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | SITE | DISTANCE | VARIABLE | MINIMUM | MEAN | MAXIMUM | ST.DEV. |
| D E 11 | Lane Ends | 0.47 | S181 | 0.00 | 0.00 | 0.00 | 0.00 |
| B B 115 | Chapel B | 0.25 | S182 | 0.00 | 0.15 | 0.30 | 0.15 |
| E E 141 | Wenning | 0.15 | S183 | 2.70 | 2.70 | 2.70 | 0.00 |
| | | | S184 | 23.50 | 23.50 | 23.50 | 0.00 |
| | | | S185 | 39.90 | 39.90 | 39.90 | 0.00 |
| | | | T181 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | T182 | 0.00 | 0.65 | 1.30 | 0.65 |
| | | | T183 | 19.90 | 19.90 | 19.90 | 0.00 |
| | | | T184 | 23.00 | 23.00 | 23.00 | 0.00 |
| | | | T185 | 14.00 | 14.00 | 14.00 | 0.00 |