SOUTH WEST WATER AUTHORITY

DIRECTORATE OF FISHERIES AND RECREATION

TECHNICAL REPORT

# FISH COMMUNITIES IN RIVERS TO BE AFFECTED BY ROADFORD RESERVOIR, 1977

Summary

Surveys were carried out on the Rivers Wolf, Thrushel, Lew and Lumburn, which are likely to be affected directly and indirectly by the construction and use of Roadford Reservoir. Of the upper reaches of three rivers to be affected directly by water releases, two were found to support abundant stocks of salmon and trout, and the third was found to contain abundant stocks of trout and eels. The River Thrushel will be affected indirectly and in this river salmon and trout stocks were present in slightly lower abundance than in others. Population estimates, densities, mean lengths and approximate biomass values were calculated. Other species were present in all rivers, usually in great abundance.

## Introduction

The construction and operation of the proposed Roadford reservoir on the River Wolf is likely to have effects on the fish communities of several rivers. This report gives details of these communities during 1977 and is the first of a series which will cover the period up to construction. Surveys were carried out from March to September but from March to June these were restricted to two rivers.

## Description of rivers

It is proposed to build a dam across the River Wolf at SX 422903 and the resulting reservoir will occupy the position shown in Figure 1. Regulating releases will flow along the Rivers Wolf, Thrushel, Lyd and Tamar to Gunnislake (SX 436712), where abstraction will occur. Water will be pumped from Gunnislake to the River Lumburn and will flow along this river and the River Tavy to Lopwell (SX 475651), where final abstraction will occur. Also, water will be pumped from Roadford reservoir to a tributary of the River Lew and will flow along this river and the River Torridge to Beam (SS 475206), where final abstraction will take place. The upper reaches which will receive regulating flows are areas where salmonid fish spawn and are reared. Sequences of riffles and pools are typical. The Rivers Wolf, Thrushel, Lyd and Lew flow over Carboniferous Culm Measures. The substrates are mainly gravels, occasional silty areas and some bedrock. The River Lumburn flows over Upper Devonian sandstone and the substrate consists of extensive silty areas with some gravel and stones. The River Tamar initially drains the Culm Measures and for several kilometres upstream of Gunnislake it drains the Upper Devonian sandstone. Chemical analyses of samples of river water show that the Rivers Wolf and Thrushel have slightly lower conductivity and alkalinity than the Rivers Tamar and Lew, whereas the River Lumburn has slightly higher values for these parameters (SWWA Water Quality 1974). Land use in these areas is mixed sheep, beef and dairy farming with extensive stands of timber.

## Methods

Surveys were done on the Rivers Wolf and Thrushel during March, April and May. Three sites were chosen on each river and it was intended to visit each site every month between March and October. River conditions and other factors made it impossible to carry out this programme and modifications were made in summer. More sites on the River Wolf, and the River Lew, were incorporated into the programme in July, and the River Lumburn in September. Reaches were identified and sections of river typical of the reaches were chosen; their positions are indicated in Figure 1. Each section was confined between stop nets and electrofished in an upstream direction three or four times. Fish were identified to species and counted, and on most occasions the majority of fish were measured, either fork length or total length depending on the shape of the caudal fin. Scale samples were taken from a number of salmonid and cyprinid fish for age identification. All fish were returned to the sections. The lengths of sections fished and widths approximately every 2 metres were measured. Mean widths and areas were calculated. Ages were assessed using length frequency histograms and scale readings. Population estimates were made using the formula derived by Zippin (1956) and 95% confidence limits attached. For salmonids this was done for each age class separately but for other species age separation was not attempted. Densities were calculated. Mean lengths and standard deviations were calculated and approximate mean weights, species and total biomass were obtained from length/weight graphs. These length/weight relationships were taken from the

literature and since they do not refer to fish from any of the rivers in Devon the estimates of weight and biomass are not precise.

Results

1. Species caught. The species caught in all rivers were salmon (Salmo salar L.), trout (Salmo trutta L.), stoneloach (Nemacheilus barbatula (L.)), minnow (Phoxinus phoxinus (L.)), bullhead (Cottus gobio L.), eel (Anguilla anguilla (L.)) and brook lamprey (Lampetra planeri (Bloch)). Not all species were present at all sites on all occasions. Two further species were present at the most downstream section on the River Lew; these were gudgeon (Gobio gobio (L.)) and dace (Leusiscus leusiscus (L.)).

2. Densities. Data for July and September are the most extensive and are presented here. Areas fished varied between 103 and 360 $m^2$. Sections varied in length between 30 and 51.4 m and in width between 3.21 and 7.17 m.Usually the wider sections were longer to accommodate both riffles and pools. Table 1 shows overall densities for all ages of salmonids and all other species except lampreys for each river and for the River Wolf upstream and downstream of the dam site. The numbers in brackets show how many sections were fished. Variations between sections were wide. In July the two upstream sections on the River Wolf had 0+ salmon densities of 150.39 and 31.19/100$m^2$ and the three downstream sections had 283.94, 36.36 and 24.11/100$m^2$. Similar variations in densities of all species were found in all the rivers. Electrofishing for lampreys was inefficient and population estimates were not made for this species.

3. Mean lengths. The overall mean lengths of all ages of salmon and trout in July and September are presented in Table 2. Mean lengths varied between sections but for both 0+ salmon and trout length was not density dependant. Trout were larger than salmon at all ages.

4. Approximate biomass. Biomass in g/100$m^2$ was calculated for all ages of salmon and trout, and for all other species except lampreys. Overall values and percentage contribution by different species are shown in Table 3.

Discussion

1. River Wolf. The drought of 1976 had a great effect on the River Wolf and at the beginning of 1977 the fish community appeared to be atypical. Salmon and trout of all ages were scarce. Although some larger trout were stocked at downstream sites their densities continued to be low and most had disappeared before July. Later in the year the few 1+ salmon and 1+ and older trout were more numerous upstream of the dam site. Although overall 0+ salmon densities were similar up and downstream of the dam site, differences between sections were great. Overall 0+ survival between July and September was higher upstream of the dam site. Between these months 0+ salmon density at Toft declined by more than 50% but that at Shop increased. Downstream of the dam site at Broadwood 0+ salmon density declined by about 67% but at Rexon and Cookworthy densities increased. This indicates a scattered distribution of spawning adults during 1976/77, followed by juvenile migrations downstream. Some areasappear to have been underutilised.

Trout densities of all ages were greater upstream of the dam site and densities of 0+ and 1+ trout increased between July and September at upstream sections, as did those of 0+ trout at downstream sections. The densities of all other ages declined. This movement of young fish may have been supported by a large stock of 0+ trout upstream of Toft or between the sections fished. In September the overall density of 0+ trout at upstream sections was less than half the 0+ salmon density.

Loach, minnow and bullhead densities were similar and low upstream of the dam site. At the downstream sections loach and minnow densities were similar and high, bullhead densities being lower. Eel densities were low throughout the river at all times.

Approximate values of biomass show the differences between upstream and downstream sites more clearly. Upstream of the dam site salmonids contributed more than 80% of the total biomass in September, whereas downstream their contribution was 20%. Total biomass/100m$^2$ was similar both up and downstream of the dam site.

2. River Thrushel. Although the sections chosen will not be affected directly by releases of water from Roadford reservoir it was thought that the River Thrushel should be studied for comparison with the River Wolf. It cannot be a true control as releases of reservoir water may affect the distribution of spawning adults. The drought of 1976 also affected the River Thrushel and the fish community was similarly atypical in spring 1977. Stocking with large brown trout was done and similarly their densities were low and erratic throughout the year.

Salmon densities were low, increasing slightly downstream. 1+ fish were few and occurred only at the lowest site. Both 0+ and 1+ densities declined between July and September. Overall 0+ densities were about half those in the River Wolf; 1+ densities were similar.

Trout densities were low, increasing upstream. Generally densities declined between July and September except in sections where initial densities were lowest. Overall trout densities were less than half the salmon densities, and younger fish were less numerous than in the River Wolf, 3+ trout being marginally more numerous.

Loach and minnow densities were generally high throughout the river and were about 66% of those in the River Wolf. Bullhead and eel densities were generally low.

In September salmonids contributed about 42% of the total biomass, and this total was low in comparison with other rivers.

3. River Lew. In July 0+ salmon densities were high at the middle (Gribbleford) and upper (Ashbury) sections but high mortality had occurred by September. At the most downstream section (Lewer Bridge) 0+ salmon density was low but little mortality occurred. In September the differences were still apparent but they were less. 1+ salmon were few but more numerous at downstream sites. Overall salmon were more numerous than in either the Rivers Wolf or Thrushel.

Densities of 0+ trout were high at Ashbury and low at Lewer Bridge. Although mortality was high at Ashbury the density in September was high. An increase in density at the downstream site indicates some movement of young fish. Densities of 1+ and 3+ trout were low, but 2+ trout were more numerous. Overall trout densities were about half those of salmon but at Ashbury the densities were similar, salmon being more numerous downstream.

Loach and minnow densities were high but variable. Bullheads were less numerous and also variable. Eels were numerous in July but few in September. Dace and gudgeon occurred at Lewer Bridge but their densities were low.

Overall biomass was higher than that in the River Wolf and about twice as high as in the River Thrushel. In September salmonids contributed about 50% of the total.

4. River Lumburn. A survey was carried out in September only. Densities of both 0+ and 1+ salmon were low at all sites. Trout densities were high overall, especially 0+ and 1+ fish, and all ages were similarly distributed throughout the river. Only one stoneloach was caught. The density of minnows was low throughout the river and overall the least of all rivers. Bullhead and eel densities were high throughout and overall the highest of all rivers. Salmonids contributed 30% of the total biomass in September and of the rest eels contributed 61% of the total (cf. Rivers Wolf 6%, Thrushel 6%, and Lew 10%). Total biomass was high, being approximately 3.5 kg/100$m^2$, almost three times as much as in the River Wolf.

## Conclusions

It is clear that upstream of the dam site on the River Wolf is an area capable of supporting high densities of salmon and trout. The same is true of the River Lew and to a lesser extent the River Thrushel. Also trout densities and biomass in the River Lumburn are high. It is not known what proportion of trout are the progeny of sea trout but it is know that sea trout use all four rivers. It is clear that total biomass is highest in the River Lumburn, which has the highest conductivity and alkalinity of the four rivers.

The programme for 1977 had certain errors of ommission which will be rectified in future years. These include extra sites upstream of the dam site on the River Wolf, on the Rivers Lew and Lumburn, and on the large rivers which will receive regulating water from the reservoir. Length/ weight relationships and age for length relationships must yet be calculated.

Acknowledgements are extended to various land and fishery owners for access and permission to work on their waters, and to Messrs. S.N.G. Steel, M.P. Gerry, E. Aze, M.E. Hancock, C.H. deQuick, L. Maddever, C.M. Newton and I. Russel and Mrs. J. Offer, S. Parsons and J. Alexander for assistance with the fieldwork.

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## References

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Table 1. Overall densities of fish, number /100m$^2$, in July and September.

| | | Separate ages ← SALMON | | TROUT | | → All ages combined LOACH | | MINNOW | | BULLHEAD | | EEL | | DACE | | GUDGEON | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JULY | SEPT | JULY | SEPT | JULY | SEPT | JULY | SEPT | JULY | SEPT | JULY | SEPT | JULY | SEPT | JULY | SEP |
| R. Wolf u/s dam site | 0+ | 90.79 | 58.01 | 21.20 | 25.49 | 28.70 | 18.26 | 29.86 | 20.51 | 3.32 | 18.74 | 2.35 | 1.26 | | | | |
| (2) | 1+ | 0.86 | 0.32 | 6.39 | 7.97 | | | | | | | | | | | | |
| | 2+ | | | 3.44 | 2.10 | | | | | | | | | | | | |
| | 3+ | | | 0.86 | 0.63 | | | | | | | | | | | | |
| R. Wolf d/s dam site | 0+ | 114.80 | 52.69 | 2.30 | 4.39 | 211.57 | 305.88 | 214.16 | 308.60 | 28.90 | 116.72 | 3.80 | 2.38 | | | | |
| (3) | 1+ | 0.10 | | 0.91 | 0.70 | | | | | | | | | | | | |
| | 2+ | | | 0.41 | 0.20 | | | | | | | | | | | | |
| | 3+ | | | | | | | | | | | | | | | | |
| R. Wolf overall | 0+ | 105.20 | 54.82 | 9.86 | 12.83 | 138.42 | 190.83 | 140.44 | 193.36 | 18.67 | 77.53 | 3.22 | 1.93 | | | | |
| (5) | 1+ | 0.40 | 0.13 | 3.10 | 3.61 | | | | | | | | | | | | |
| | 2+ | | | 1.62 | 0.96 | | | | | | | | | | | | |
| | 3+ | | | 0.34 | 0.25 | | | | | | | | | | | | |
| R. Thrushel overall | 0+ | 49.16 | 25.70 | 13.20 | 7.92 | 163.62 | 116.46 | 150.35 | 113.44 | 11.73 | 33.65 | 0.87 | 0.96 | | | | |
| (3) | 1+ | 0.21 | 0.13 | 2.00 | 0.94 | | | | | | | | | | | | |
| | 2+ | | | 0.65 | 0.64 | | | | | | | | | | | | |
| | 3+ | | | 0.43 | 0.44 | | | | | | | | | | | | |
| R. Lew overall | 0+ | 134.72 | 62.14 | 58.35 | 26.18 | 111.55 | 91.08 | 363.36 | 86.06 | 72.79 | 46.84 | 30.43 | 5.93 | 0.25 | 0.33 | 0.63 | 0.4 |
| (3) | 1+ | 1.25 | 0.47 | 4.70 | 3.21 | | | | | | | | | | | | |
| | 2+ | | | 1.93 | 1.54 | | | | | | | | | | | | |
| | 3+ | | | 0.13 | 0.11 | | | | | | | | | | | | |
| R. Lumburn overall | 0+ | | 1.60 | | 20.02 | | 0.19 | | 37.54 | | 129.69 | | 86.48 | | | | |
| (4) | 1+ | | 0.52 | | 13.23 | | | | | | | | | | | | |
| | 2+ | | | | 2.67 | | | | | | | | | | | | |
| | 3+ | | | | 1.17 | | | | | | | | | | | | |
| | 5+ | | | | 0.16 | | | | | | | | | | | | |

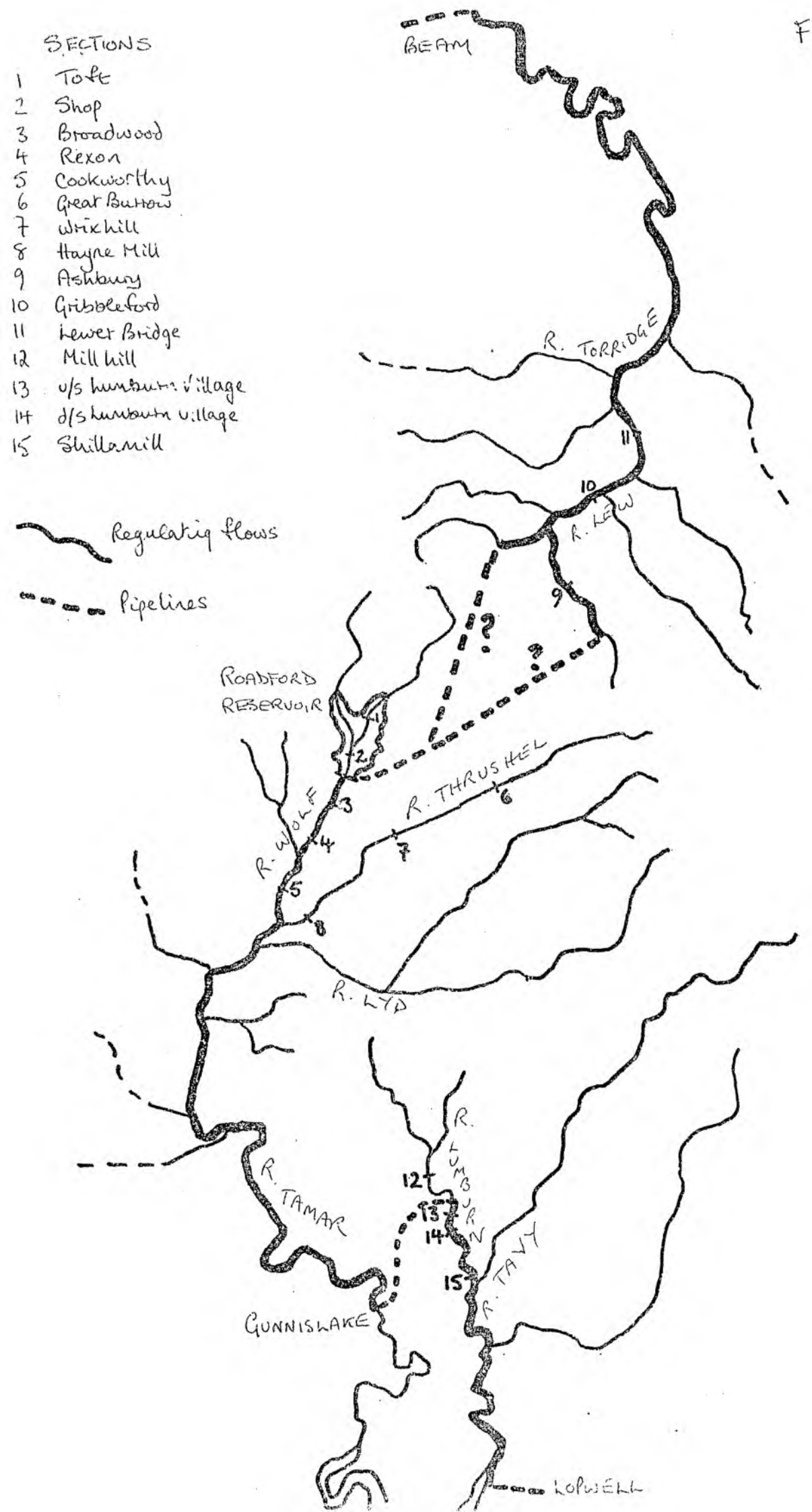
Table 2. Overall mean lengths in cms. of salmon and trout in July and September.

| | | Salmon | | Trout | |
|---|---|---|---|---|---|
| | | July | Sept. | July | Sept. |
| R. Wolf u/s dam site | 0+ | 5.31 | 6.41 | 6.62 | 8.08 |
| (2) | 1+ | 12.50 | 12.70 | 14.05 | 15.12 |
| | 2+ | | | 18.64 | 19.56 |
| | 3+ | | | 22.58 | 26.85 |
| R. Wolf d/s dam site | 0+ | 5.43 | 6.41 | 6.41 | 7.72 |
| (3) | 1+ | 11.00 | | 13.99 | 16.10 |
| | 2+ | | | 17.50 | 17.90 |
| | 3+ | | | | |
| R. Wolf overall | 0+ | 5.39 | 6.41 | 6.59 | 8.01 |
| (5) | 1+ | 12.28 | 12.70 | 14.04 | 15.23 |
| | 2+ | | | 18.47 | 20.84 |
| | 3+ | | | 22.58 | 26.85 |
| R. Thrushel overall | 0+ | 5.29 | 6.23 | 6.52 | 7.53 |
| (3) | 1+ | 12.30 | 12.40 | 14.15 | 15.27 |
| | 2+ | | | 19.36 | 19.52 |
| | 3+ | | | 24.25 | 24.53 |
| R. Lew overall | 0+ | 5.75 | 6.61 | 6.93 | 8.27 |
| (3) | 1+ | 13.51 | 13.85 | 14.23 | 15.24 |
| | 2+ | | | 18.65 | 20.06 |
| | 3+ | | | 25.00 | 25.70 |
| R. Lumburn overall | 0+ | | 7.72 | | 8.09 |
| (4) | 1+ | | 11.90 | | 14.22 |
| | 2+ | | | | 17.99 |
| | 3+ | | | | 22.93 |
| | 5+ | | | | 31.00 |

Table 3. Approximate biomass in g/100m$^2$ and percentage contribution in July and September

| | | July | | September | |
|---|---|---|---|---|---|
| R. Wolf u/s dam site | Salmon | 185 | 15.00% | 194 | 15.35% |
| (2) | Trout | 695 | 56.37% | 851 | 67.33% |
| | Eel | 139 | 11.27% | 40 | 3.16% |
| | Others | 214 | 17.36% | 179 | 14.16% |
| | | 1233 | | 1264 | |
| R. Wolf d/s dam site | Salmon | 221 | 15.81% | 169 | 14.01% |
| (3) | Trout | 66 | 4.72% | 75 | 6.22% |
| | Eel | 180 | 12.87% | 106 | 8.79% |
| | Others | 931 | 66.60% | 856 | 70.98% |
| | | 1398 | | 1206 | |
| R. Wolf overall | Salmon | 207 | 15.55% | 179 | 14.55% |
| (5) | Trout | 317 | 23.82% | 386 | 31.38% |
| | Eel | 163 | 12.25% | 80 | 6.50% |
| | Others | 644 | 48.38% | 585 | 47.56% |
| | | 1331 | | 1230 | |
| R. Thrushel overall | Salmon | 92 | 9.29% | 78 | 11.05% |
| (3) | Trout | 250 | 25.25% | 222 | 31.44% |
| | Eel | 41 | 4.14% | 41 | 5.81% |
| | Others | 607 | 61.31% | 365 | 51.70% |
| | | 990 | | 706 | |
| R. Lew overall | Salmon | 1026 | 32.57% | 232 | 16.01% |
| (3) | Trout | 585 | 18.57% | 504 | 34.78% |
| | Eel | 948 | 30.10% | 142 | 9.80% |
| | Others | 591 | 18.76% | 571 | 39.41% |
| | | 3150 | | 1449 | |
| R. Lumburn overall | Salmon | | | 21 | 0.60% |
| (4) | Trout | | | 1035 | 29.73% |
| | Eel | | | 2123 | 60.99% |
| | Others | ___ | | 302 | 8.68% |
| | | | | 3481 | |

FIGURE 1.


SECTIONS
1 Toft
2 Shop
3 Broadwood
4 Rexon
5 Cookworthy
6 Great Burrow
7 Wrixhill
8 Hayne Mill
9 Ashbury
10 Gibbleford
11 Lewer Bridge
12 Mill hill
13 u/s Lumburn village
14 d/s Lumburn village
15 Shillamill
Regulating flows
Pipelines
BEAM
R. TORRIDGE
R. LEW
ROADFORD RESERVOIR
R. WOLF
R. THRUSHEL
R. LYD
R. TAMAR
R. LUMBURN
R. TAVY
GUNNISLAKE
LOPWELL