THE Tweed FOUNDATION

A Tweed Foundation Paper

Appendix 1: Assessing the effects of Instream Structures on Salmonid spawning: An example from the Teviot, a lowland Scottish Salmon river

1 Most instream structures (fords, bridge foundations, weirs, etc) are partial barriers to migratory fish rather than total barriers – they restrict the numbers of fish getting upstream rather than stop them completely.

2 This means that the simple presence of juvenile salmon and trout upstream of an instream structure cannot be taken as meaning that it is not a barrier to spawning adults at all. It is only by finding out if there are the same numbers upstream as downstream that this can be shown.

3 If there are fewer juvenile fish upstream than downstream, then the instream structure is restricting spawning access, even though it is not totally preventing it.

4 The standard way of measuring fish numbers in smaller streams is electric-fishing (*Fish are "attracted" to the +ve probe of an electric-fishing machine, so the fish can be collected. They recover as soon as they are out of the electric current*). A measured area or a set time is sampled at each site so that the numbers of fish are known to have come from a similar sampling effort. This means that the numbers of fish from different sites can be compared.

5 Map A shows the numbers of salmon fry found in three minutes electric-fishing from sites throughout the catchment of the Teviot, a tributary of the Tweed. The results have been grouped into five classes :

Black	**0** Salmon Fry in three minutes electric-fishing
Red	**1 to 8**
Orange	**9 to 16**
Yellow	**17-23**
Light Green	**24-30**
Dark Green	**31-70**

and these are shown as different colours on the map.

6 There are three instream "structures" also shown on this map: (A) The Slitrig "Rock Shelf"; (B) the Weens Fish Pass; and (C) the "Salmon Leap" waterfall.

7 It is clear from the map that at these obstacles, the electric-fishing results change, dropping from Green to Red or Yellow classes, showing that there are fewer juvenile salmon upstream than downstream.

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8 The results can be summarised as:

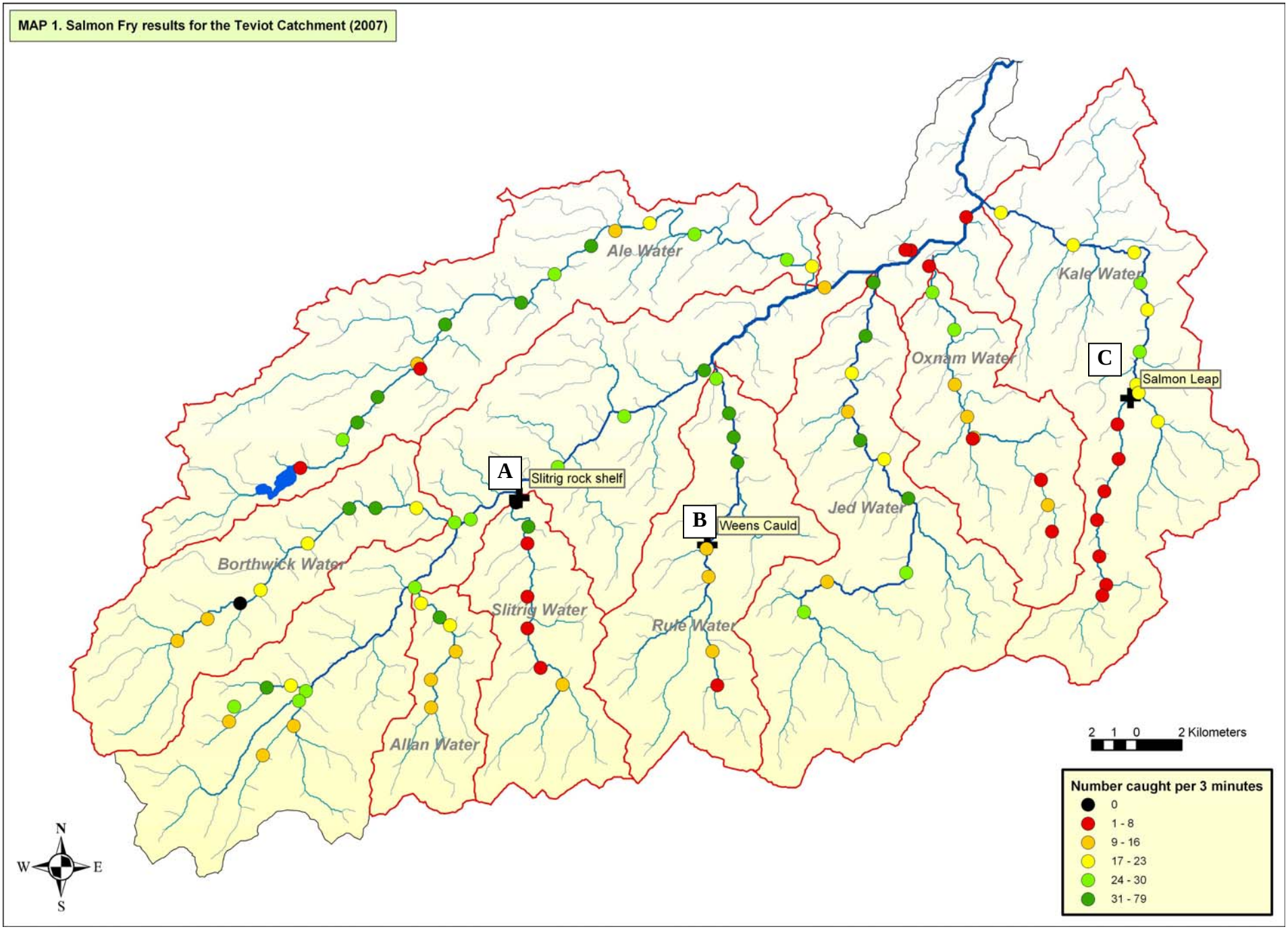
Instream Structure	Dominant results class (Nos in 3mins)	
	Below	Above
A (Rock Shelf)	(no sites)*	**1-8**
B (Weir)	**31-70**	**9-16**
C (Waterfall)	**17-23**	**1-8**
* *compare to other tributaries generally instead.*		

9 It is clear therefore that while none of these obstacles is a total barrier to spawning fish, all are partial obstacles, restricting the numbers of juveniles upstream and therefore reducing the reproductive capacity of the river.

10 A Norwegian paper (Halley & Lamberg, 2001) has been very widely referenced as showing that mere presence of juvenile salmon upstream of a set of Beaver dams proved that they were not a barrier to salmon at all. No quantitative electric-fishing was carried out in this study, the results give only presence / absence of Salmon fry. Nor was there any indication that the amount of sampling effort at each site was the same – i.e. some sites could have been sampled for much longer or over a wider area than others, making comparison between the numbers of fish caught at the different sites invalid. Despite these problems, this paper has been very wide quoted as showing that adult salmon had no problem in passing the Beaver dams in the stream study – although there is a very specific disclaimer in the paper itself that this was not being claimed by the authors: " *salmon were capable of moving upstream past all of the dams, despite the fact that dams 1 and 4 in particular were large and solid structures. It is less clear at what stage of life (as young fish or adults or both) that this takes place. Evidence elsewhere suggests that movements of young salmon, especially 0+ individuals* (Fry) *is very restricted, and the vast majority which do move do so downstream from the hatching site …… This suggests, but does not prove, that adult individuals were responsible for the above-dam populations. Direct observations in the spawning season would be necessary to answer this point conclusively*." It should also be noted that only around 30 Salmon fry were found in total at the three sites sampled for this study. As an average sized, 70cms long female salmon produces around 5,000 eggs, of which 80-90% will hatch, it is not at all clear that there was any salmon spawning at all in this stream – many more fry should have found if there had been any actual redds in the study area (judging by Scottish standards)

11 It is clear, however, that if such a simple presence / absence assessment was applied to the results from the Teviot shown above, none of the obstacles would be classed as a barrier to fish at all – and no management action would be called for.

12 Quantitative sampling, however, shows quite clearly that all three of the obstacles are restricting access of spawning salmon upstream and reducing the productive capacity of the river. The same sort of sampling and analysis must be applied to the assessment of Beaver dams before any valid statements can be made as to their impact on salmonid spawning.


MAP 1. Salmon Fry results for the Teviot Catchment (2007)
Ale Water
Kale Water
Oxnam Water
C
Salmon Leap
A
Slitrig rock shelf
B
Weens Cauld
Jed Water
Borthwick Water
Slitrig Water
Rule Water
Allan Water
2 1 0 2 Kilometers
Number caught per 3 minutes
0
1 - 8
9 - 16
17 - 23
24 - 30
31 - 79
N
W
E
S