Eddie Eyre
18055485@brookes.ac.uk

The Suitability of the Upstream Gala Water for Atlantic Salmon (*Salmo salar*) Spawning

Introduction: Life Cycle, Justification and Objectives

Born in small freshwater rivers → Reside in the river for 1-3 years → When matured, migrate to sea in the spring → After 1-5 years feeding at sea, return to home river to spawn → ~90% of Atlantic salmon die after spawning

Justification:

1. Global and UK decline in salmon population.
2. Importance of salmon to the regional economy and culture
3. Lack of current research on the River Tweed's tributaries and their significance to the salmon population.

Figure 1 - The location of the River Tweed in Southern Scotland. This map presents the rivers known to host wild salmon populations across Scotland, with the Tweed river network encircled in red (Franklin, Verspoor and Slaski, 2012).

Objective 1
Establish the suitability of the depth, velocity and vegetation of the upstream Gala Water for salmon spawning.

Objective 2
Identify any major obstacles to migration limiting access to the upstream Gala Water.

Study Area and Methods

Figure 2 - Map of the River Tweed tributary network (Queen's University Belfast, 2021).

- The Tweed river basin is dominated by agriculture – little industry limited to larger towns. The Gala Water is a tributary of the Tweed.
- The Tweed runs ~150km East to West, draining into the North Sea.
- Salmon fishing and tourism brings ~£24 million into the region, and employs over 500 people (Tweed Forum, 2021).

- The Gala Water runs ~35km North to South.
- Primary research conducted on 14 sites along a 2.27km stretch of the upper course.
- Hilly, isolated area, dominated by pastoral agriculture.

Figure 3 - Research site 8 (author's own photograph).

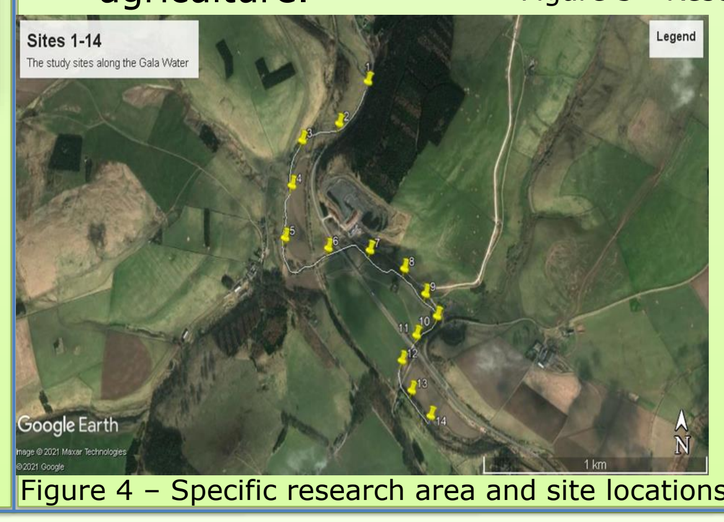

Figure 4 – Specific research area and site locations

- At 14 sites; depth and velocity measured; land use, vegetation and availability of cover recorded in detail.
- Satellite imagery, first hand knowledge and secondary sources used to establish downstream land use and threats to migration.

Results and Discussion

Table 1 – Depth and velocity suggestions from previous research, and results from the upstream Gala Water.

Research	Depth (m)	Velocity (m/s)
Soulsby et al, 2001	0.2-0.25	0.5-0.65
Moir, Soulsby and Youngson, 2002	0.12-0.66	0.22-1.29
Louhi, Maki-Petays and Erkinaro, 2008	0.2-0.5	0.35-0.65
Upstream Gala Water results (across all fourteen sites)	Mean = 0.381 Range = 0.266-0.516	Mean = 0.635 Range = 0.487-0.796

- Certain depths and velocities are more ideal for spawning than others. Table 2 presents suggested depths and velocities from three research papers, along with the results from the Gala Water for comparison.
- Overall, the Gala Water's depth and velocity are very suitable.

- Land use dominated by wild woodland and grassland.
- Gala Water had abundant cover; overhanging branches, undercut banks, deep pools, bridges and boulders (figure 3 and 5).
- Cover highly important - shelters salmon from sunlight and predators during the spawning process, maturation and migrations (Milner, 1982).

Figure 5 - Research site 14 (author's own photograph).

Downstream:
- Some pollution from electronics industry in Galashiels and Selkirk – not enough to stop migrations.
- Damn in Galashiels, but a fish ladder effectively passes this.
- Overall, access to the upstream Gala Water is not restricted.

References:
- Franklin, P., Slaski, E., and Verspoor, R. (2012) 'Impacts of Open Pen Freshwater Aquaculture Production on Wild Fisheries,' *Technical Report*, DOI:10.13140/RG.2.1.4226.3127.
- Louhi, P., Maki-Petays, A., and Erkinaro, J. (2008) 'Spawning habitat of Atlantic Salmon and Brown Trout: general criteria and intragravel factors,' *River Research and Application,* 24)3), pp.330-339.
- Milner, N.J. (1982) *Habitat evaluation in salmonid streams*, in 'Proceedings of the 13th Annual Study Course,' Institute of Fisheries Management, pp.47-65.
- Moir, H., Soulsby, C., and Youngson, A. (2002) 'Hydraulic and sedimentary controls on the availability and use of Atlantic salmon spawning habitat in the River Dee system, North East Scotland,' *Geomorphology,* 45(3-4), pp.291-308.
- Queen's University Belfast (2021) *Controlling Priority Invasive Species: Tweed,* Available at: https://www.qub.ac.uk/research-centres/cirb/RiverCatchments/ScottishCatchments/Tweed/ (Accessed: 14 March 2021).
- Soulsby, C., Youngson, A., Moir, H. and Malcolm, H.J. (2001) 'Fine sediment influence on salmonid spawning habitat in a lowland agricultural stream; a preliminary assessment,' *Science of the Total Environment,* 265(1-3), pp.295-307.