

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

BSc Geography Dissertation

Edward Eyre (18055485@brookes.ac.uk)

Contents

1. Introduction
 - a. Background and Objectives
 - b. Justification
2. Study Area
 - a. Wider Region
 - b. Specific Research Area
3. Methods
4. Results and Discussion
 - a. Hydraulic Data
 - b. Land Use and Vegetation
 - c. Downstream
5. Conclusions



Figure 1 – research site 6/7 (author's own photograph).



Figure 2 – Atlantic salmon (NOAA Fisheries, no date).

1. Introduction

a) Background

- Atlantic salmon are found across the North Atlantic.
 - Scotland hosts a strong population – can also be found across England and Wales.
- Born in freshwater, usually small tributary rivers where they mature for one to three years.
- Migrate to sea in the spring, where they feed for one to five years, before returning to their home river to spawn.
- Gala Water is a small rural river in Southern Scotland, a tributary of a famous salmon river, the River Tweed.
- Objectives:
 - Establish how suitable the hydraulic conditions, land use and vegetation of the upstream Gala Water are for hosting Atlantic salmon spawning.
 - Identify any obstacles downstream and in the wider region which could inhibit salmon migration to the upstream Gala Water.

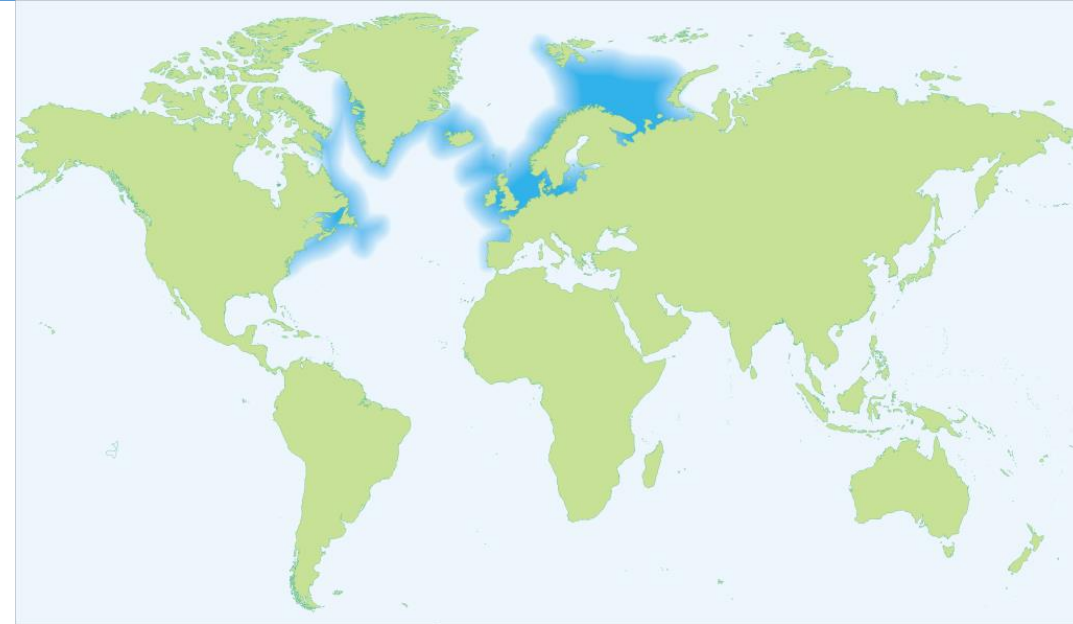


Figure 3 - Global distribution of Atlantic salmon (Franklin, 2016).

1. Introduction

b) Justification

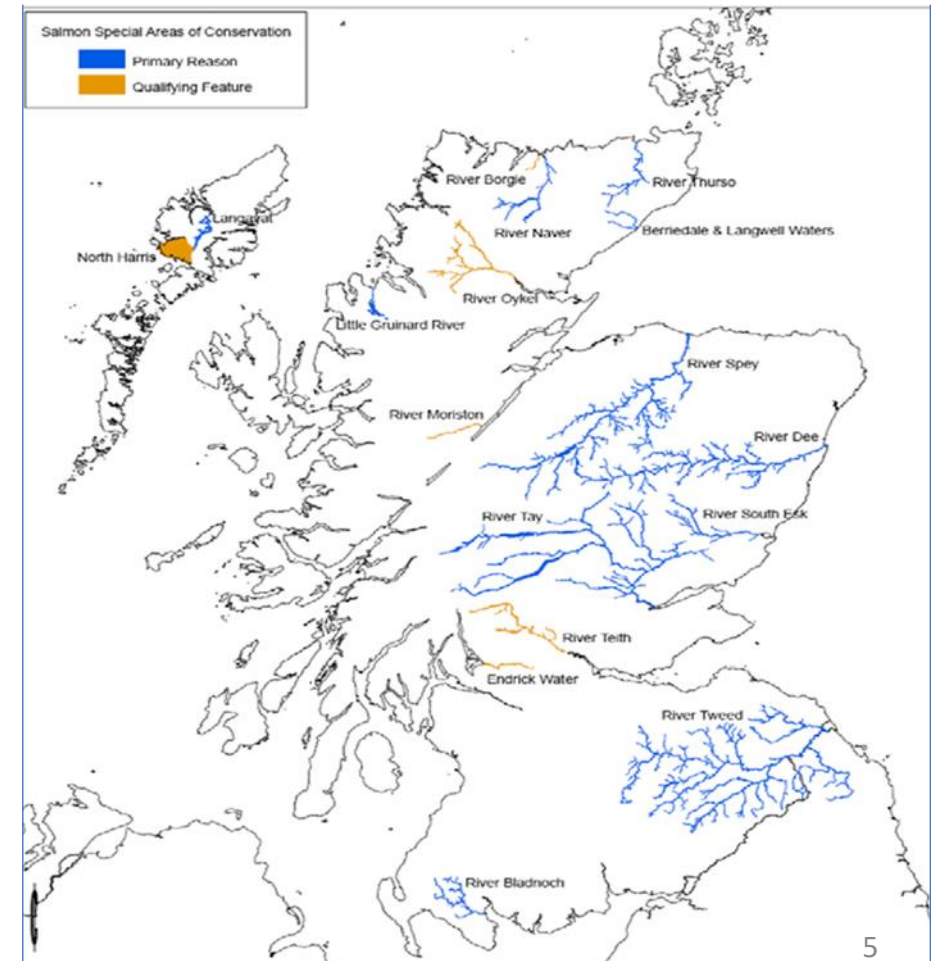
- Decline in population globally, within the UK, and within Scotland.
 - Scotland one of four countries home to 90% of wild salmon (Iceland, Ireland, Norway) – very important to conservation on a global scale (Thorstad *et al*, 2011).
- Importance of salmon to the region.
 - Salmon fishing on the Tweed employs 500+ people and brings around £24 million to the region annually (Tweed Forum, 2021).
- Lack of current research.
 - There is very little research into the tributaries of the Tweed, despite their importance to the local salmon industry.
 - The Gala Water specifically has almost no literature on it, and seemingly none regarding salmon.

2. Study Area

a) Wider Region

- River Tweed is a large river in Southern Scotland, running ~150km East to West, draining into the North Sea.
- Hilly, rural region dominated by agriculture.
- Low level of industry, focused on Galashiels and Selkirk.
- Gala Water flows 35km North to South, joining the Tweed ~2km South of Galashiels.
- Average of 808mm of rainfall per year (Met Office, no date).
- Temperature averages between 0.3 to 18.5°C (Met Office, no date).

Figure 4 - Special Areas of Conservation for Atlantic salmon in Scotland (Malcolm, Godfrey and Youngson, 2010).



2. Study Area

b) Specific Research Area

- 2.27km stretch of the upstream Gala Water, approximately 15km upstream of the confluence with the Tweed.
- Hilly area dominated by pastoral agriculture – sheep and cattle.
- Coniferous plantations on slopes ill-suited to farming.
- The village of Fountainhall lies immediately to the South (downstream) of the specific research area.



Figure 5 - River Tweed catchment (Queen's University Belfast, 2021)

3. Methods

- Sites were chosen approximately 165m apart, avoiding uncommon anthropogenic disturbances (e.g. fords).
- Fieldwork conducted in late October to early November to coincide with the spawning season.
- Depth, velocity and width measured. Detailed observations of the vegetation, banks, availability of cover and surrounding land use recorded.
- Satellite imagery, first-hand knowledge and secondary sources (previous literature and research) were utilised to identify obstacles to upstream migration and land use.



Figure 6 - Specific research area with site locations (Google Earth Pro).

4. Results and Discussion

a) Hydraulic Data

Research	Depth (m)	Velocity (m/s)
Gibson, 1993	0.25	0.3-0.45
Soulsby <i>et al</i> , 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	Mean = 0.381 Range = 0.266-0.516	Mean = 0.635 Range = 0.487-0.796

Table 1 – Presents suitable depths and velocities for spawning provided by previous research, along with the mean and range for these characteristics across the fourteen research sites of the upstream Gala Water.

- Depth and velocity suitability is evaluated by comparing the Gala Water's data with previous research into active salmon spawning locations.
- The depth of the Gala Water fits extremely well into these parameters, indicating a very suitable depth for spawning.
- The Gala Water's velocity was on the higher end of the parameters set, but is generally within the broader ranges suggested.

4. Results and Discussion

b) Land Use and Vegetation

- Milner (1982) suggests that some form of cover is the single most important feature of spawning habitat
- Necessary for upstream and downstream migrations, during the spawning process, and by juveniles as they mature (Kennedy, 1984; Crisp, 1996).
- Can be provided by; overhanging branches; undercut banks; boulders; grasses/rushes/reeds; bridges; deep pools.



Figure 7 - Site 7 (author's own photograph).

4. Results and Discussion

b) Land Use and Vegetation

- The East bank was closely split between wild deciduous woodland and wild grassland.
- The West bank was dominated by wild grassland, with wild woodland and pastoral fields occurring twice each.
- Abundant cover:
 - Significant overhanging branches at six of the fourteen sites.
 - 1km of continuous woodland on East bank.
 - Five bridges (railway and road).
 - Three notably deep pools near sites 6, 10 and 13.
 - Undercut banks most notably at sites 8 and 9.
 - Rip rap at two locations provides excellent nursery habitat.



Figure 8 - Site 8: wild woodland on the East bank, wild grassland on the West bank to the bottom left (author's own photograph).

4. Results and Discussion

c) Downstream

Factor	Gala Water	River Tweed
Overall condition	Moderate	Moderate to Good
Water quality	Good	Good to High
Physical condition	Moderate	Good
Access to fish migration	High	High

Table 2 - SEPA official ratings of relevant river qualities from the Gala Water and River Tweed (SEPA, 2015)

- Overall, there is little to inhibit salmon from reaching the upper courses of the Gala Water – this is reflected in the SEPA ratings for access to fish migration.
- Some pollution occurs from the electronics industry in Selkirk and Galashiels, but not on a scale as to inhibit salmon migrations (Robson and Neal, 1997).
- Skinworks Cauld is the only physical barrier – a fish pass overcomes this obstacle (Tweed Foundation, 2015).
- Both rivers benefit from their rural location, lack of nearby industry, and the notoriety of the Tweed as a salmon river encouraging conservation groups and schemes.

5. Conclusions

- The upstream Gala Water is a suitable site for Atlantic salmon spawning.
 - Depth and velocity are overall suitable for spawning to occur, being within parameters set by prior research into active spawning locations.
 - There is plentiful cover provided by deep pools, overhanging branches, bridges, undercut banks and boulders – facilitates migration, habitation and nurseries.
 - Surrounding land use is natural or agricultural and has little negative impact on the river.
- There are no major obstacles restricting access to the upstream Gala Water.
 - What little pollution there is appears to be on a small enough scale to not inhibit salmon migrations.
 - The Skinworks Cauld is the only physical barrier, and this is remedied with a fish ladder.

5. Conclusions

- Limitations:
 - Small scale – only a limited area could be researched in detail. Downstream areas could only be broadly reviewed.
 - Lack of access to laboratories – limited what characteristics of the Gala Water could be sufficiently analysed.
- Future research:
 - Sediment size of the bed of the Gala Water.
 - Investigate the severity of the pollution from industry in Galashiels and Selkirk.

References

- Crisp, D.T. (1996) 'Environmental requirements of common riverine European salmonid fish species in fresh water with particular reference to physical and chemical aspects,' *Hydrobiologia* (323), pp.201–221.
- Franklin, C. (2016) 'Atlantic Salmon (*Salmo salar*),' *Nature Table*, Available at: <https://animalcaseprofile.wordpress.com/2016/05/01/atlantic-salmon-salmo-salar/> (Accessed: 6 April 2021).
- Gibson, R.J. (1993) 'The Atlantic salmon in fresh water: spawning, rearing and production,' *Reviews in Fish Biology and Fisheries*, 3(1), pp.39-73.
- Kennedy, G.J.A. (1984) 'The ecology of salmonid re-instatement following river drainage schemes' *Institute of Fisheries Managemnt (NI Branch) Conference Proceedings. University of Ulster*, pp.1-13.
- 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.

References

- Malcolm, I.A., Godfrey, J. and Youngson, A.F. (2010) 'Review of migratory routes and behaviour of Atlantic salmon, sea trout and European eel in Scotland's coastal environment: implications for the development of marine renewables,' *Scottish Marine and Freshwater Science*, 1(14).
- Met Office (no date) *UK climate averages – Galashiels*, Available at: <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcvurvzxs> (Accessed 26 January 2021).
- 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.
- NOAA Fisheries (no date) *Atlantic Salmon (protected)*, Available at: <https://www.fisheries.noaa.gov/species/atlantic-salmon-protected> (Accessed: 8 April 2021).
- Queen's University Belfast (2021) *Controlling Priority Invasive Species: Tweed*, Available at: <https://www.qub.ac.uk/research-centres/cirb/RiverCatchments/ScottishCatchments/Tweed/> (Accessed: 7 April 2021).

References

- Robson, A.J. and Neal, C. (1997) 'Regional water quality of the river Tweed,' *Science of the Total Environment*, 194, pp.173-192.
- SEPA (2015) *River Basin Management Plan*, Available at: <https://www.sepa.org.uk/data-visualisation/water-environment-hub/> (Accessed: 7 April 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.
- Thorstad, E.B., Whoriskey, F., Rikardsen, A.H. and Aarestrup, K. (2011) 'Aquatic nomads: the life and migrations of the Atlantic salmon,' *Atlantic Salmon Ecology*, 1(6), pp.1-32.
- Tweed Forum (2021) *Catchment Area*, Available at: <https://tweedforum.org/our-work/catchment-facts/> (Accessed: 25 January 2021).
- Tweed Foundation (2015) *Gala Fish Counter Results 2015*, Available at: https://www.tweedfoundation.org/GA_2015_general_report.pdf (Accessed: 14 March 2021).

—

Thank you very
much for listening.



Figure 9 - Site 13 (author's own photograph).