Marine Directorate
Topic Sheet
January 2026

Scottish Government
Riaghaltas na h-Alba

The role of river flow magnitude and timing in Atlantic salmon return migration to the Girnock and Baddoch catchments

Figure 1: River Dee and Girnock Burn confluence showing low flow access conditions (2024 - Girnock discharge 0.16 m³/s).

Figure 2: River Dee and Girnock Burn showing high flow access conditions (2025 - Girnock discharge 0.52 m³/s).

Introduction

Across the North Atlantic, the number of salmon returning to home waters to spawn has declined over several decades. In Scotland, 2023 was the lowest rod catch on record, and although catches improved slightly in 2024, many rivers remain at historic lows. Spring salmon stocks have been particularly affected by negative trends, with catches generally declining since records began in 1952. The Girnock (Figure 1&2) and Baddoch are two intensively monitored sub-catchments of the Aberdeenshire Dee that have been studied since 1966 and 1988 respectively and are dominated by spring run multi-sea winter salmon. Pairs of fish traps collect information on the numbers, sizes and ages of fish migrating to and from the sea, providing a detailed understanding of changing populations and the factors affecting them. Interpretation of these data is supported by studies of physical habitat, river flows, water quality and river temperature.

This topic sheet is an update of the previous summary “Trends in the number of female Atlantic salmon returning to the Girnock and Baddoch traps” and has been extended to consider the influence of year-to-year flow variability on observed spawner numbers in tributary streams.

Long-term trends in salmon numbers

Spring salmon catches on the River Dee have declined by around 95% since 1952 (Figure 3). The numbers of adult female salmon returning to

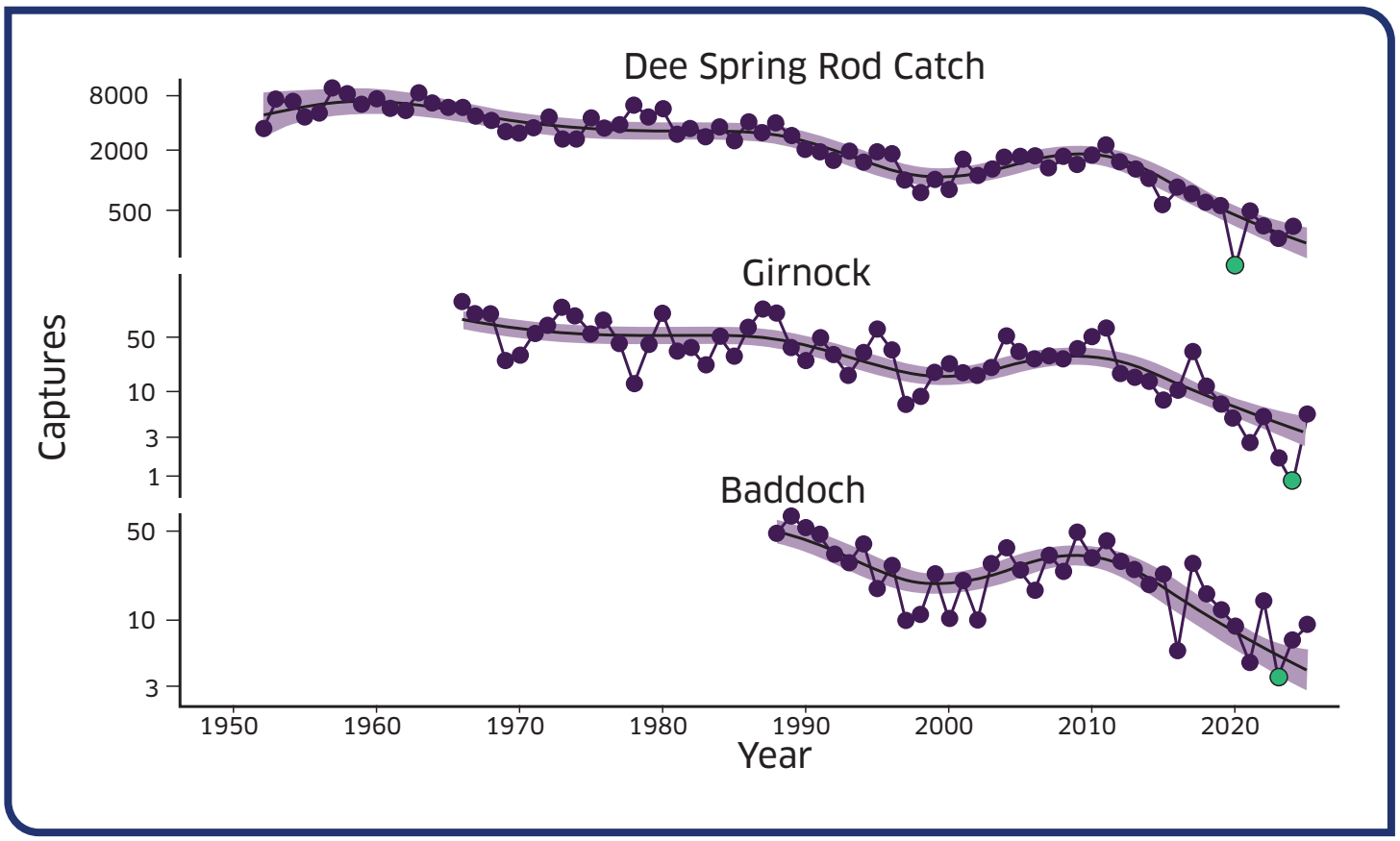

Figure 3: Trends in the Aberdeenshire River Dee spring rod catch, and Girnock and Baddoch female numbers over time. The lowest value in each time series is marked in green. Trends are shown as black lines with 95% confidence intervals as shaded purple bands. Note that the lowest point in Dee spring rod catch (2020) was affected by COVID restrictions.

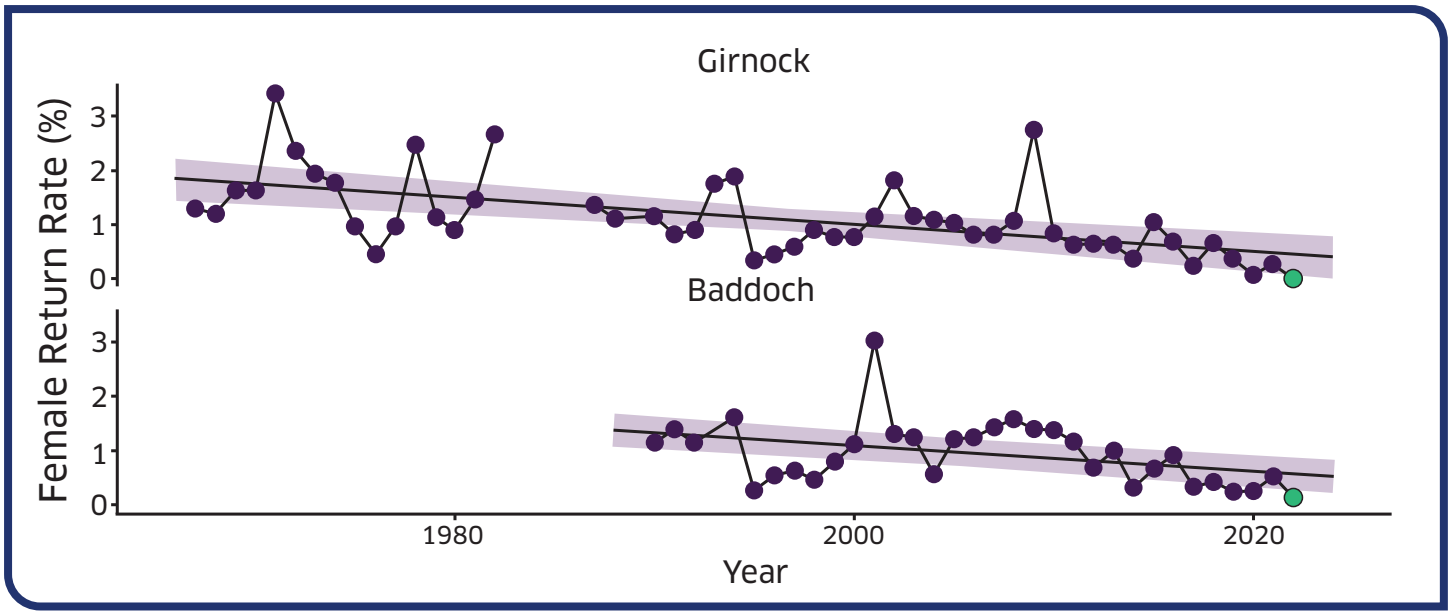

Figure 4: Trends in the Girnock and Baddoch female return rate as a percentage of emigrants over time. The year of migration to sea is shown on the x axis. The return rate can reflect adult returns across multiple years depending on sea age at return. The lowest value in each time series is marked in green. A common trend best explained patterns in return rate across the two sites and is shown as black lines with 95% confidence intervals as shaded purple bands.

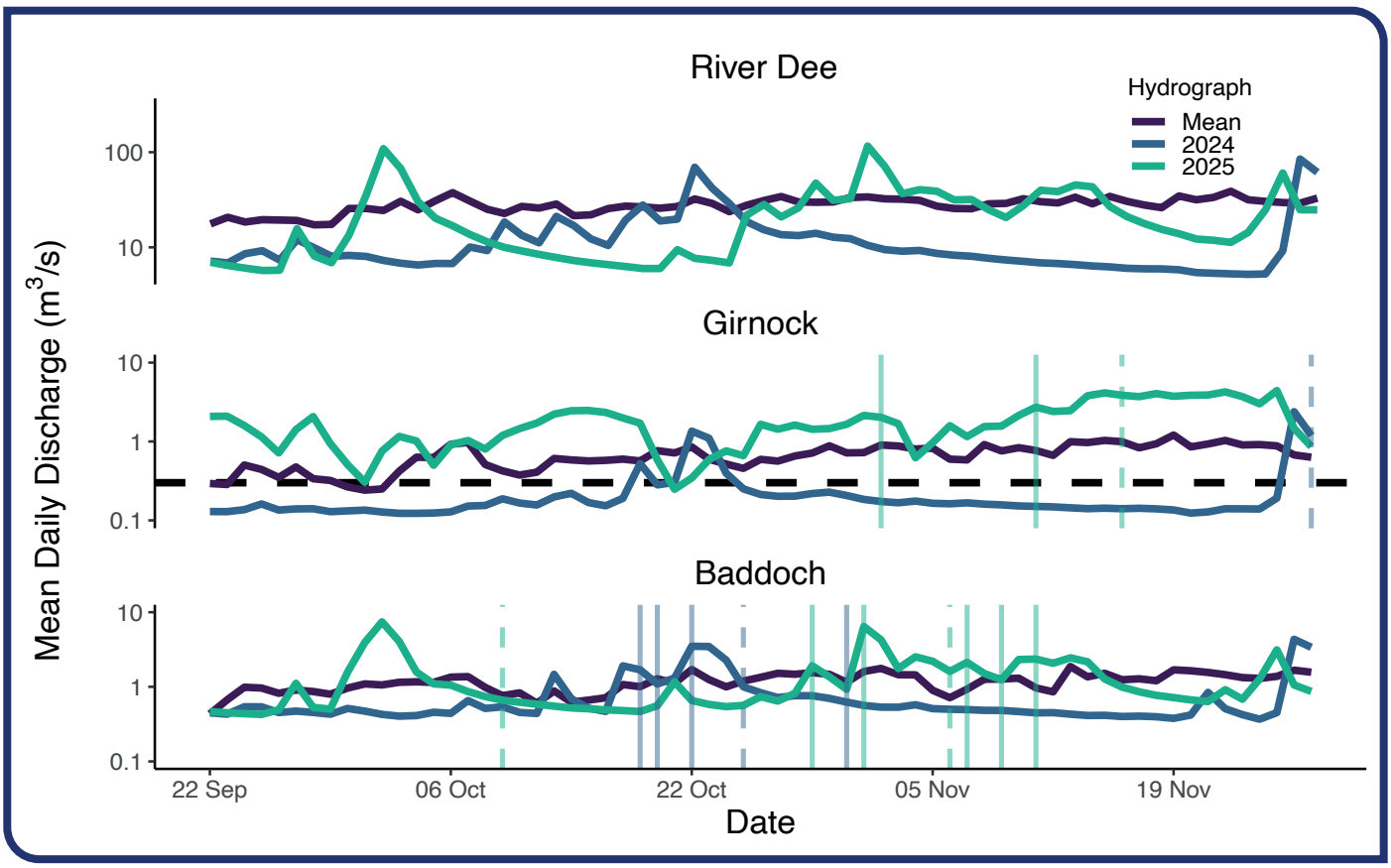

Figure 5: Mean daily discharge for River Dee, Girnock and Baddoch in 2024, 2025 and averaged across the available timeseries for each site. Note that the 'River Dee' values are for the Polhollick SEPA gauging site, which is immediately downstream of the Girnock Burn confluence. Vertical bars denote dates on which females were captured. Dashed vertical bars indicate capture between the traps where large spates exceeded the height of the adult trap screens. The horizontal dashed line on the Girnock hydrograph represents the discharge threshold (~0.30 m³/s) below which access to the upper Girnock Burn was thought to be constrained prior to channel change following Storm Frank in 2015. Note the y axis is on a log scale.

the Girnock and Baddoch in 2025 were the joint 4th (6 females) and joint 6th (9 females) lowest on record respectively, showing small increases from 2024 (one and seven). Long-term changes in the River Dee spring rod catch, and the number of females returning to the traps, are best explained by a common trend over time indicating a consistent decline across all three datasets (Figure 3). This suggests that the salmon population processes observed in the Girnock and Baddoch sub-catchments are representative of those affecting spring salmon on the Dee more broadly. Observed downward trends in adult numbers largely reflect a major (75%) reduction in return rate (the percentage of juvenile emigrants returning as adult female salmon) from ca. 1.8% in 1966 to 0.4% in 2022 (Figure 4). However, downward trends have also been exacerbated by reductions in freshwater production in recent decades as ova deposition is no longer sufficient to saturate available habitat.

Inter-annual variability in salmon numbers

Local environmental variability can also affect the number of adult returns (and thus also return rate) in particular locations and years. Previous work has demonstrated that access to the upper Girnock catchment depends upon the availability of high flows at spawning time, a relationship that has likely been exacerbated by major channel change since Storm Frank at the end of 2015. Similar analyses suggest that access to the Baddoch is less constrained. Autumn 2024

and 2025 were characterised by strongly contrasting flow conditions that are likely to have affected counts of spawners differently in those years. Autumn 2024 was characterised by unusually low river flows across the Dee until late November (Figure 5). In contrast, autumn 2025 saw repeated high flows through this important period, with mean daily discharge exceeding the threshold for access identified in previous work on all but one day (Figure 5). Such conditions provide greater opportunities for fish to access the upper Girnock catchment, and this is likely reflected in the increase in female returner numbers in 2025, compared to 2024.

Summary

The numbers of female salmon returning to the traps in 2025 are higher than 2024 at both sites, but remain fourth and sixth lowest on record respectively. These values are consistent with wider trends in the abundance of Dee spring salmon as indicated by the rod catch data. While long-term trends in adult numbers are driven primarily by multi-decadal reductions in marine survival, this has been exacerbated by reductions in production of freshwater emigrants in recent decades. Inter-annual variability in adult salmon numbers can also be relatively large and are strongly affected by autumn flows that constrain physical access in some sub-catchments.

Further Reading

Glover, R., & Malcolm, I. (2015). Girnock and Baddoch: Adult returns to the traps. https://doi.org/10.7489/1588-1

Glover, R., Eagle, L.J.B., Jackson, F.L. & Malcolm, I. (2026 first published). Girnock and Baddoch: Adult Return Rates. DOI: 10.7489/1607-2

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Marine Directorate (2025). Trends in the number of female Atlantic salmon returning to the Girnock and Baddoch traps. Topic Sheet.

Soulsby, C., Malcolm, I.A. and Tetzlaff, D. (2024). Six decades of ecohydrological research connecting landscapes and riverscapes in the Girnock Burn, Scotland: Atlantic salmon population and habitat dynamics in a changing world. Hydrological Processes, 38:3. https://doi.org/10.1002/hyp.15105.

Tetzlaff, D., Soulsby, C., Youngson, A. F., Gibbins, C. N., Bacon, P. J., Malcolm, I. A., & Langan, S. J. (2005). Variability in stream discharge and temperature: A preliminary assessment of the implications for juvenile and spawning Atlantic salmon. Hydrology and Earth Systems Science, 9, 193–208. https://doi.org/10.5194/hess-9-193-2005

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