

To what extent is loch habitat important for production of larger salmon smolts in the Badachro river?

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From 12th April to 26th May 2021, the Wester Ross Fisheries Trust operated a smolt trap at the outflow of Loch Bad a' Chrotha. The project was part of the collaborative West Coast Salmon Tracking Project led by the Atlantic Salmon Trust in partnership with Marine Scotland Science and Fisheries Management Scotland.

Our primary objective was to find out whether at least 100 salmon smolts of lengths greater than 140mm could be caught to demonstrate that the location a suitable place for tagging salmon smolts as part of the tracking project in future years.

Most juvenile salmon from stream systems in Wester Ross grow slowly because of limited food availability within the stream habitats they typically inhabit (see '[About ecosystem nutrition and juvenile salmon smolt production in Wester Ross](#)').

However from studies elsewhere in previous years we have learned that where there is a relatively large freshwater loch in the river system, the proportions of larger smolts may be higher. At Tournraig, for example, larger smolts were recorded in some years which from scale reading appear to have grown on more rapidly within loch habitat prior to smoltification (please see [WRFT Review 2016](#) Box 2.1).

So our choice of the pool below the outflow of Loch Bad a' Chrotha was based on the possibility that there could also be a higher proportion of larger salmon smolts than we might find at most other locations within Wester Ross, so a better chance of recording over 100 smolts of over 140mm without catching too many. Because smolt trapping interrupts the emigration of smolts, our aim was to intercept only a minor proportion of the smolt run. The trap location below the loch outflow was also conveniently close to the WRFT office and to the road.

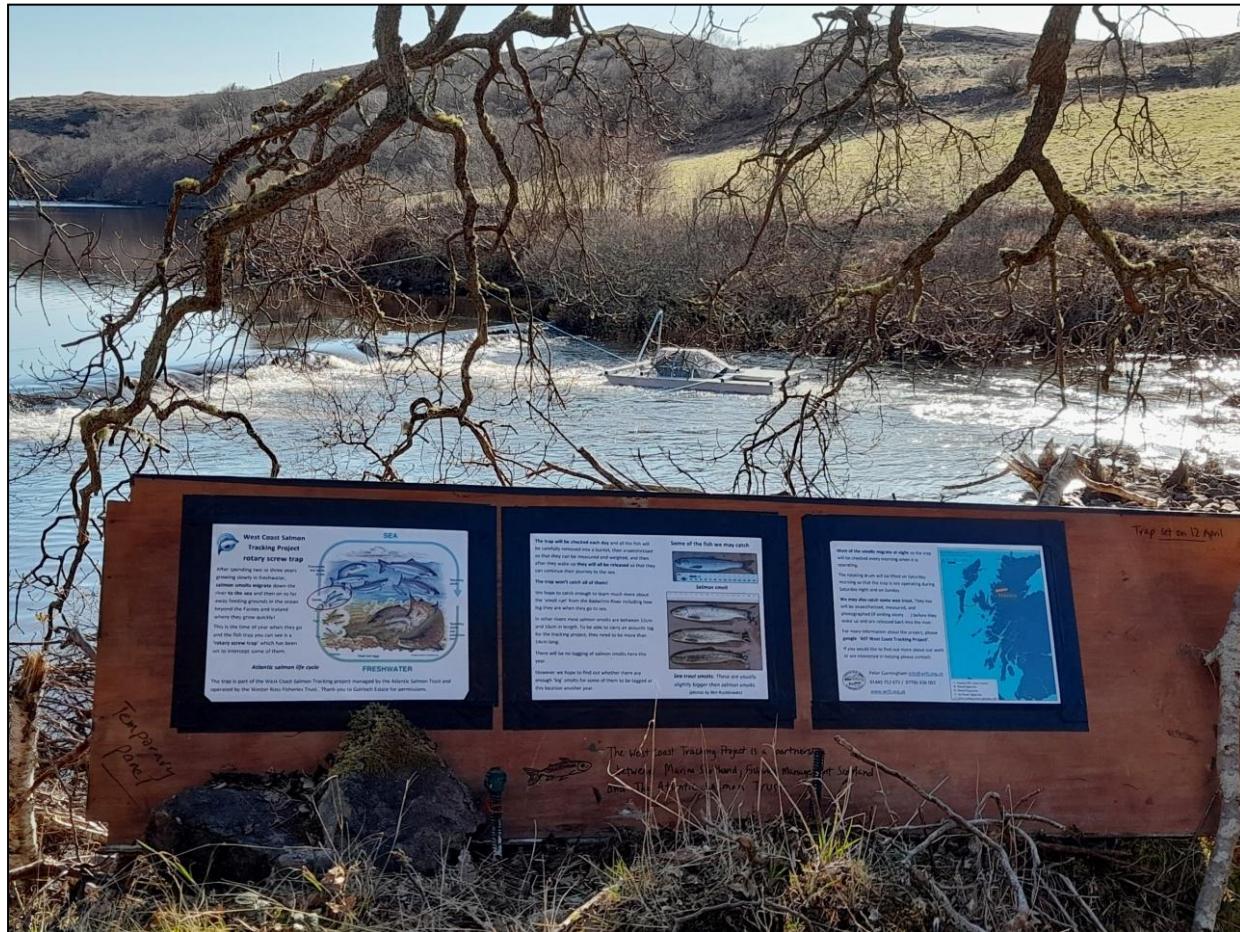
On the 12th of April 2021, a rotary screw trap [RST] was successfully deployed with help from Bill Whyte. A temporary information board was put up to enable passersby to follow progress and to learn more about the project. The trap was initially operated 4 or 5 days per week Monday to Saturday, with the 'drum' lifted on Saturday so that it did not fish on Sundays. However, by 24th April water levels were inadequate for the RST to operate. So a fyke net was set behind the RST to provide an additional means of obtaining samples of smolts.

The trap was checked first thing every morning when in operation and sometimes also later in the day. All fish were lightly sedated to enable them to be measured, and then, after recovery, returned to the river below the trap.

By 12th May, the primary objective had been met with over 100 smolts of 140mm or more in length recorded, despite low flows. Thereafter the trap was set to sample fish for only two nights per week to learn more about the duration of the smolt run with as little interruption as possible.

The trap was operated on and off until 26th May.

Badachro rotary screw trap and scoreboard at start of project, 12th April 2021. Trap counts were added after each trap check!

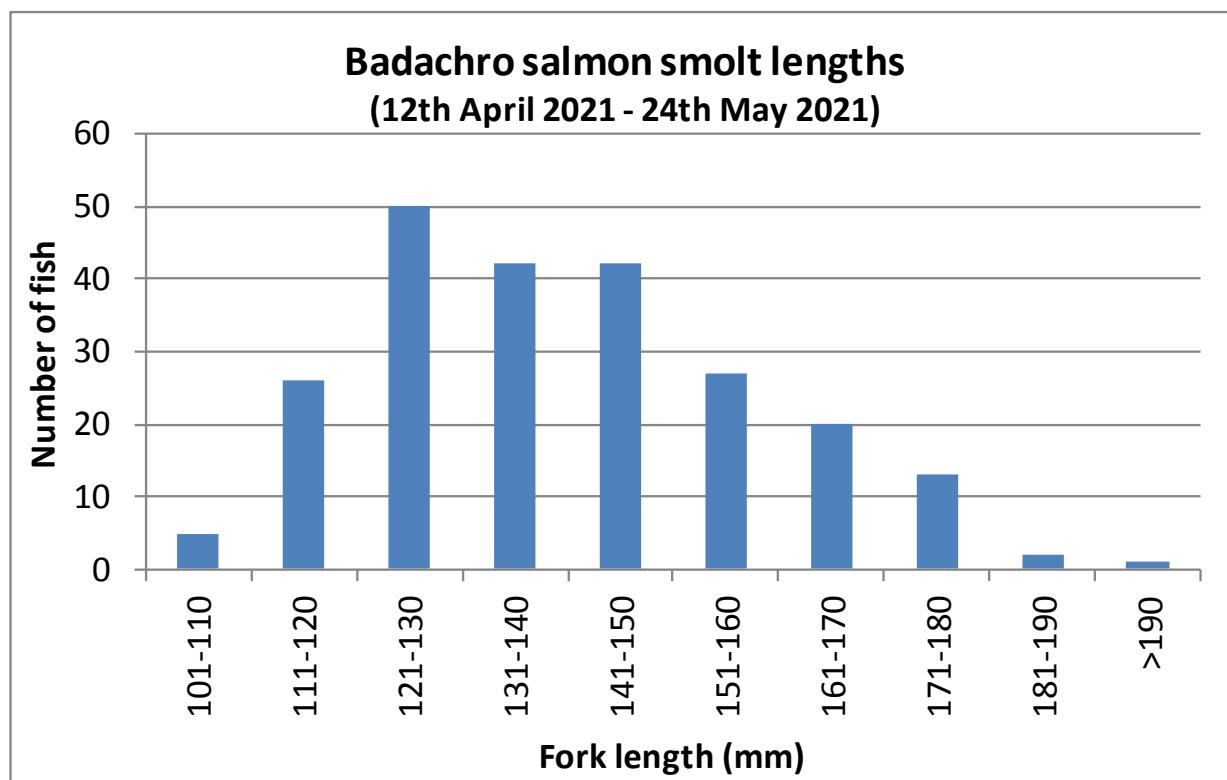


Results

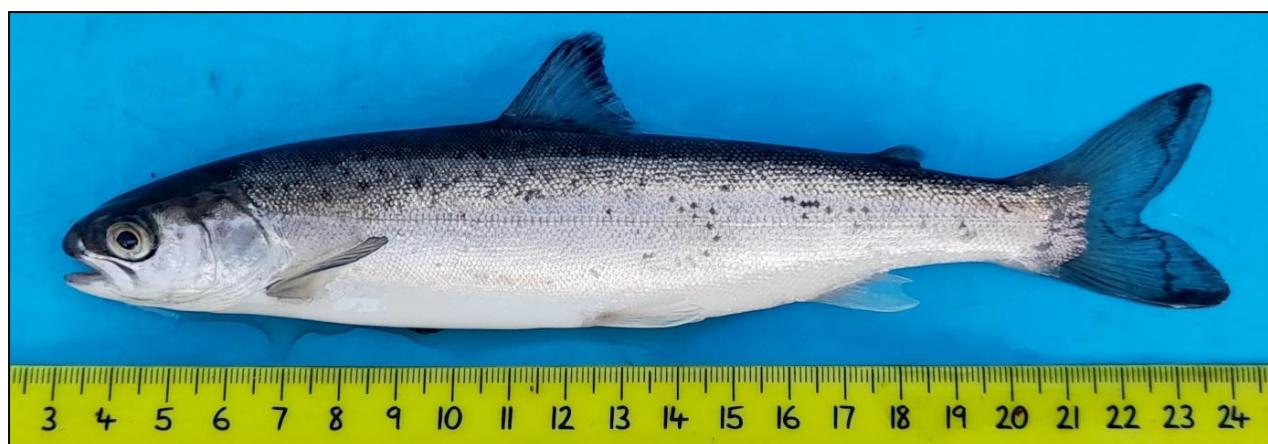
Altogether 228 salmon smolts, 7 salmon parr, 2 sea trout smolts, 3 brown trout and one eel were caught. Of the salmon smolts, 110 (48%) were of 140mm or more in length. The smallest was 107mm (12.0g) and the largest 192mm (70.7g). Figure 1 is a graph of fork lengths of salmon smolts in the sample.

Smolts of different sizes were caught throughout the sampling period. However a higher proportion of larger smolts were caught towards the beginning of the sampling period. 56% of the 140 smolts caught in April were >140mm in length, compared to just 31% of the 88 smolts caught in May. The longer smolts (>140mm) also had slightly higher average body condition factor than the shorter smolts (body condition factor 0.998 vs. 0.979); in other words they were slightly ‘fatter’.

Figure 1. Fork lengths of salmon smolts trapped in the pool below the Loch Bad a' Chrotha outlet weir, from 12th April to 24th May 2021.



The longest salmon smolt caught; 192 mm; Badachro trap, 22nd April 2021



Discussion

Over 100 salmon smolts of over 140mm were caught during the trapping period. This was achieved by 12th May without having to keep the traps in operation non-stop. However, without using a fyke net in addition to the rotary screw trap, it may not have been possible to catch 100 smolts of >140mm. A combination of RST and fyke worked well.

There may have been a tendency for larger smolts to begin emigration ahead of the smaller smolts. Or perhaps because many of the larger smolts were living in the loch immediately above the trap

prior to the smolt migration period, they reached the trap earlier than the smaller smolts which set off around the same time but mostly from riverine habitat further upstream? Another possibility is that larger smolts tended to stop moving downstream before the smaller smolts as water levels dropped to very low levels.

Larger smolts have been shown to have higher rates of marine survival than smaller ones. For example, Armstrong et al (2018) demonstrated from studies of marked smolts from the nearby River Conon in 1999 - 2014 that the probability of a smolt of 130mm returning from marine migration was less than 0.04 (<4%) compared to more than 0.05 (>5%) for a 160mm smolt; and furthermore that migrating earlier and having higher condition factor was also associated with higher rates of return. Gregory et al (2020) reached similar conclusions.

Badachro salmon smolts, 29th April 2021



So in terms of supporting and sustaining the salmon population in the Badachro River, lacustrine habitat within Loch Bad a' Chrotha may be of much importance by contributing to the production of bigger, stronger salmon smolts.

Scale samples have been taken to learn more about smolt age and growth in comparison to smolts sampled elsewhere.

Only two sea trout smolts were recorded. This was initially unexpected because sea trout are regularly encountered in the sea near the mouth of the Badachro River. However anglers with experience of fishing Loch Bad a' Chrotha over many years reported that sea trout are rarely caught in Loch Bad a' Chrotha. This has been so for many years, Mills and Graesser (1992) state in '*The Salmon Rivers of Scotland*' that '*angling is for salmon only as no sea trout ascend the Badachro*'. Is

this because waterfalls in the gorge below the loch are virtually insurmountable to sea trout but not salmon?

Other rivers in Wester Ross where salmon have been much more frequently recorded upstream of waterfalls than sea trout over the past 100 years include the Ullapool River and the Little Gruinard river.

It would therefore seem likely that most of the sea trout encountered near the mouth of the Badachro river originate in stream systems elsewhere.

A lack of competition from progeny of sea trout may be one reason why juvenile salmon may have a slightly bigger share of habitat and food resources in Loch Bad a' Chrotha compared to lochs in other larger river systems where both salmon and sea trout are present? However there are brown trout within Loch Bad a' Chrotha, so the lack of 'sea' trout may not be of such significance, unless it is also to do with the numbers of juvenile trout produced within the system; large female sea trout tend produce many more eggs than smaller trout which remain within freshwater because of better feeding in the sea. Larger salmon parr, especially pre-smolts, may simply be well adapted for life in stillwater habitats where they are able to evade capture from piscivorous brown trout and other animals.

In addition to demonstrating that the Loch Bad a' Crotha outflow is a suitable location for obtaining a sample of 140mm+ salmon smolts for tagging (assuming similar success in future years), the Badachro smolt trap project has raised a number of interesting questions about the importance and utilisation of freshwater 'loch' habitat for salmon populations within the Wester Ross area.

There is relatively little information about the importance of loch habitat compared to stream habitat for supporting wild salmon populations in Scotland and elsewhere (see Lennox et al, 2021 for review); further investigations could be useful. Other salmon systems in Wester Ross with large areas of freshwater 'loch' habitat include the rivers Ullapool, Gruinard, Little Gruinard [Special Area of Conservation for Atlantic Salmon], Ewe and Balgy. Are lochs Achall, na Sealga, Fionn Loch, Maree and Damh also of importance for producing larger, more robust wild salmon smolts, with better prospects of completing their life cycle? Are the salmon populations in these systems likely to have greater reliance to climate change?

Acknowledgements

Thank you to Gairloch Estate and the Shieldaig Lodge Hotel for permissions to deploy the trap in the Badachro River. The traps were operated by Peter Cunningham, Chris Beresford and Roger McLachlan with help from Dr James Close, Scott Buchan, Lloyd Gudgeon and Bill Whyte. Thank you to Dr Lorna Wilkie for help with arrangements. Thank you to the many people who stopped by the roadside for a chat including Dr Alastair Stephen for information about salmon parr in the loch. The project was funded by the West Coast Salmon Tracking Project, a partnership between the Atlantic Salmon Trust, Marine Scotland Science and Fisheries Management Scotland.

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Chris Beresford releasing smolts after their recovery from sedation, 5th May 2021

