Beauly
Fishery Board

Trial Trap and Truck study proposal v2 21/10/2025 RW

<u>Project overview</u>

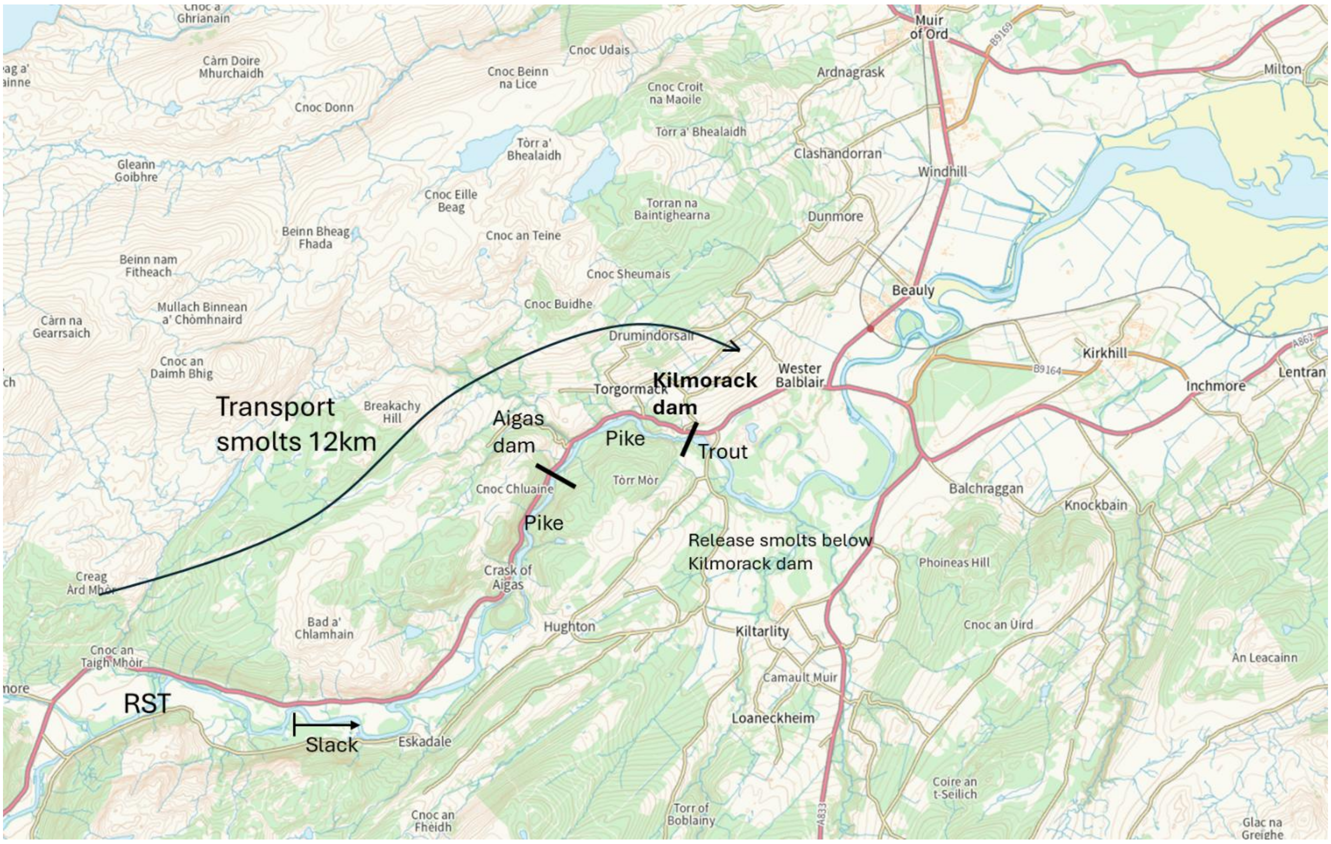
Beauly Fishery Board would like to commence a trial trap and truck operation on the R. Beauly with the aim of improving smolt survival out of the catchment.

We hope to take a pro-active management approach and **have a positive impact on smolt output sooner rather than later**, whilst monitoring if this trial mitigation is effective or not.

<u>The plan</u>

1. PIT tag smolts at the Erchless trap.
2. Hold in boxes at release sites, release at night. Release half (with untagged counterparts) downstream of Kilmorack dam, and release half (with untagged counterparts) to continue on their usual route out of the catchment through 9km of slack, pike inhabited water, and 2 turbines.
3. A PIT antennae installed at the top chamber of Kilmorack dam will record the resultant adult return.

Information gained from this monitoring would give us insight into whether this version of 'trap and truck' could improve the prospects of smolts leaving the catchment or not. This is likely to be the case based on the experience of the Conon and Kyle of Sutherland catchments.



From communication with Atlantic Salmon Trust we would aim to tag 2,000 smolts for each treatment (but less may be sufficient [perhaps 1,500] pending advice from Marine Directorate). As we want to release these tagged fish with 50% untagged counterparts to retain natural migratory behaviours and reduce predation we would ideally want to capture a total of 8,000 smolts at the Erchless RST.

Capturing 8,000 smolts in a single season at the Erchless trap is theoretically possible but unproven at this stage so we are likely to do this trial mitigation over 2-3 years to attain the number of smolts required. Conducting this study over several years allows smolts to encounter a range of river and sea conditions which could make the findings of this study more robust.

Night release has been shown to improve smolt survival significantly on the Conon so we will do this where possible, although this is not always effective (e.g. at Kyle of Sutherland).

<u>Possible risks with controls</u>
-*Increased straying of adults as a result of interrupted imprinting during smolt emigration*. The control is that we would initially be trapping a low proportion of smolts (<5% of estimated total smolt output) to see if translocation is of genuine benefit. The furthest a smolt can migrate in the Beauly catchment is c45km, the length of translocation is 12km, so translocation would make up a minimum of about a third of the smolt's journey out of the catchment. This is a significant risk and would apply to a total of 4,000 (2,000 tagged, 2,000 untagged) smolts out of the 8,000 smolts included in this study. Carrying out this study over several years reduces the overall % of the annual smolt run required to be translocated in a single year, minimising risk even further.
-*PIT tagging and handling is associated with some mortality* (perhaps <1%). Night release ensures that only live fish leaving the holding boxes are included in the study and we can keep an eye if handling is impacting smolt survival. We will minimise handling and transport time. Smolt transport in the Conon and KOS catchments occurs using air pumps. On the Ness it occurs using Oxygen with diffuser. We are likely to transport smolts using Oxygen with diffuser method to ensure the highest smolt welfare during transport. We anticipate the journey to take 15minutes and will minimise smolt holding time before this. We will also use a tank with sluice (rather than netting smolts out of the tank) to minimise handling and ensure fast release into the holding boxes.
-*Smolts reaching the sea prematurely* ahead of appropriate sea surface temperature/ food supply. Currently smolts are likely to be delayed in their migration exiting the catchment* so reducing emigration time should help them reach the sea at the correct time although salmon in the catchment will have evolved with hydro…?
-*Predators primed by smolt release*. We will release tagged fish with untagged counterparts to increase release group size and reduce predation pressure. We may have to consider varying the location of release, this is why night release is favoured.
-*Review* of the effectiveness of this mitigation will be ongoing. Once 4,000 smolts have been tagged and released, a couple of years will be necessary to allow the resultant return of the adults. Therefore if tagging is carried out in 2027, 2028, and 2029 then a full review and analysis will be done in 2032.
-*The decoder not being installed in time* to detect tagged fish. Installation of a PIT tag decoder entails a long lead-in time (>4.5 months) and there are likely to be constraints regarding installation windows i.e. Dec-Feb when the fish pass is not operational. We would want the PIT tag decoder installed or strong assurance/ support from SSE before tagging any smolts.

Project timescales

2025: Gain permission from SSE to install PIT tag decoder at Kilmorack dam. Visit Kilmorack dam with SSE, measure the top chamber.
Early 2026: Secure funding for the project, order PIT tag decoder.
April-May 2026: monitor the smolt run at Erchless RST and commence trap and truck to iron out any practical issues.
Winter 2026/2027 install PIT tag decoder at Kilmorack (or earlier if possible).
April-May 2027, 2028, 2029**: PIT tagging of 4,000 smolts, with release of 4,000 untagged counterparts. Annual collation of results.
2032*: Full analysis of results (possibly by third party).

**precise timings may vary depending on success of PIT tagging and adult return patterns. It may take 1-3 smolt seasons to attain the 4,000 smolt tagging (total of 8,000 smolt) target. Most adults return as grilse, however, based on 2023 rod catch data there may be approximately a third returning as multi sea winter fish.

Background info

We think approximately 102,684 smolts (75,050-144,383) exit the whole catchment each year extrapolating from adult fish counts and area based estimate***. Approximately 88% of these smolts (90,362) may pass the Erchless trap site on their outward migration. If, for example, we can improve survival of just 4,000 smolts, and assuming a 5% sea survival rate, then we would hope for an increase in adult return of approximately <200. Monitoring is necessary to assess the effectiveness of this mitigation as there are risks associated, it is staff resource intensive, and clearly smolts do make it out of the catchment on their current route.

The Farrar genetics study has highlighted there being twice the number of adults spawning below Beannacharan dam as above it. This may imply a potential problem of smolt or adult fish passage on the Farrar in the context of there being suitable spawning substrate above the dams as well as below. Currently smolts have to travel down the fish pass at the dam which is a narrow (c1.5m) gap in the dam with no attraction flow to guide smolts. Loch Beannacharan is home to pike, so any delay in smolt migration through Loch Beannacharan is likely to impact smolt vulnerability to predation. Although trap and truck and further study of smolt survival by installing a PIT tag decoder on the Farrar in relation to smolt passage through loch Beannacharan is a favoured option to improve smolt survival, it currently does not seem practically possible to carry out this work as we cannot find a suitable RST site. Tagging autumn parr could be a possibility in the future combined with looking at adult return at Kilmorack but further exploration of options is required.

Trapping at Erchless (relatively far down the catchment) means that we have the potential to increase the survival of many smolts compared to just those produced from the Farrar. If the mitigation is shown to be effective, we can continue to implement trap and truck whilst improving trap efficiency, whilst this is in the interests of the fish.

Installation of a PIT tag decoder at Kilmorack is essential to several study ideas previously considered. This particular mitigation and study design has been chosen because it is likely to directly improve returning adult numbers and it is a realistic aspiration to secure funding and deliver this work.

This mitigation is part of wider work the board is doing to improve smolt output and protect salmon and sea trout in the catchment. E.g. minimising illegal exploitation, gravel augmentation below the dams to restore habitat, encouraging increased riparian tree cover in the upper catchment, predation control…etc.

<u>Calculations/ evidence to support assumptions</u>

**Current delay of smolts exiting the catchment*. This is based on the observation that peak numbers of smolts are caught in the Erchless trap just 3km above the unnatural slack water above Aigas in the first week of May, however peak numbers observed at the Aigas dam gate slots (10km downstream) occurs around the first week of June. This would imply that smolts may be taking a month to transit the slack water above Aigas. This is compared to the expected 10 days (at 1km/day rule of thumb) expected under natural conditions.

We also have observations from staff during the smolt run observing thousands of smolts above Aigas dam in the early mornings. The turbine shafts are c10m below the surface of the water. This is an unnatural route for smolts to take, when they usually travel along the water surface, and there is therefore likely to be a delay in them finding the route out.

There is a significant amount of evidence (see references) to suggest that smolt emigration and survival is significantly negatively affected when travelling through standing water, especially if pike are present.

****Smolt output estimate based on fish counts*. The 10yr average fish count at Kilmorack (2013-2022) is 3705 (this will be the minimum fish count as counts are often incomplete). Adding 25% for general mk12 and previous counter undercount, this gives a minimum estimated adult return of 4631 fish to Kilmorack. If we add 11.2% (509 fish) based on the additional accessible area below Kilmorack (including Belladrum) this suggests there are **approximately 5140 salmon returning to the entire catchment**.

Adult-egg-smolt calculation: Based on 2021 information from the Conon assume 40% of adults are hens (2056 hens), 3650 eggs/ hen (7,504,999 eggs), 1% survival of egg to smolt= **75,050 smolts**. Please note this is an estimate only. The actual assumption figures will vary widely from year to year.

Smolt-Adult calculation: If 5% sea survival is 5140 fish then 100% would be **102,800 smolts**.

ICES WGNAS 5 yr adult return rate mean 2015-2019 from UK monitoring is 4.3% for grilse and 2.1% for MSW. 2023 rod catch shows c33% MSW and 66% grilse for Beauly catchment. Therefore **you could assume an average return of 3.56% for a Beauly smolt**. If 3.56% sea survival is 5140 fish then 100% would be (x 28.09)= **144,383 smolts**

Smolt output based on area. The accessible area to salmon in the Beauly catchment excluding lochs is approximately 2,212,274m2. Area based estimate of smolt production assuming 4 per 100m2 comes out with an estimated smolt output of **88,504 smolts for the entire catchment**.

References

[1]Forrester et al (2025) The effect of downstream translocation on Atlantic salmon Salmon salar smolt outmigration success. Journal of Fish Biology 2025:106:376-388.

[2] Honkanen et al (2021) The downstream migration success of Atlantic salmon (Salmo salar) smolts through natural and impounded standing waters. Ecological Engineering (Vol: 161, 1 March 2021, 106161).

[3] Orell (2017) Survival and movement behaviour of Atlantic salmon smolts (Salmon salar L.) migrating through impounded lakes and natural standing waters. University of Glasgow, CFFT, SSE, SEPA.

[4] Pritchard (2025) Genetic evaluation of the Breeding structure of the Atlantic Salmon Population of the Farrar River Final Project Report, Years 1-4. UHI Institute for Biodiversity and Freshwater Conservation.

Costings for trap and truck mitigation with PIT tagging to compare smolt survival through dam infrastructure Vs trap and truck

Item	Cost	Supplier and Details	Comments
FDX-B-ORG PIT tag antennae	£2520 (£2,100 +VAT £420)	WMD 1.5x0.5m. Assume powered by electricity on site	Need to update measurements- visit to dam required with SSE.
PIT tag reader	£1800 (£1,500 +VAT £300)	WMD	Order before Xmas
12mm FDX-B-tags (x 4,000)	£8064 (£5040+£1680= £6720 +VAT £1344)	WMD £1.68/tag x 3000, or £2625 for 1500 (£1.68/tag for 1000, £1.89/tag for 500).	Order before Xmas
Cabling	£1,800 (£1,500 +VAT £300)	WMD	
Transducer	£480 (£400+£80)	WMD	
Basic USB download facility	£300 (£250 +VAT £50)	WMD	Pay more for remote access, or alternative data viewing options e.g. download to phone. Considering data transfer issues SSE are having would prefer manual download, but SSE might insist on remote data transfer.
Installation	£6000 (£5,000 ish +VAT £1000)	WMD	Will vary
Boat to access RST	£500-750	Cat C [Boatworld Lite 220] [Honwave T20 SE Slatted Floor Inflatable Boat]	Category C – tidal rivers, estuaries and large, deep lakes and lochs where the significant wave height could not be expected to exceed 1.2 metres at any time Category D – tidal rivers and estuaries where the significant wave height could not be expected to exceed 2 metres at any time
Transport tank with sluice and slide.	£1622.40 (£1352+VAT £270.40)	Purewell TT2 479L OR AirWaterFish 600L plus LIN valve, sluice, hose etc (£2,482+VAT)	Fit in back of truck, capacity comfortable for 600 smolts, more if transport with Oxygen.
Water pump	£634.5 (£528.75+VAT £105.75)	AirWaterFish or AJS (Honda engine pump 1" with 10m suction hose, and 5m delivery hose)	
Smolt release boxes x4	£800ish	£150 each plus staff time to modify them. £30-50 per timed door. Marine ply headboard.	
MS222 anaesthetic	Unknown		
Staffing (extra person for 5 weeks, half days) 1 season only.	£1,836	£17/hr. 4hrs/day=£68/day. £68x27 days= £1,836	This would be the second/ scribe of the team. Could be a trainee/ intern/ seasonal bailiff.
Staffing (separate PIT tagging team to cover 4 days off) 1 season only.	£4,000	£1000/ day for 2 person PIT tagging team (Ness, Conon or equivalent)	Could perhaps do an exchange of labour instead.
Total inc VAT	**£30,606.90**		

Green = Trap and truck only

Assumptions

Based on 1 month of PIT tagging inc weekends (31 days).

Assume have use of SSE's 6ft RST. Already have air pump, but new one would be £246.93+VAT (AirWaterFish 12v 140L/min). Already have PIT tag hand reader. Would need more MS222. Consideration is being given to oxygenated transport. This would involve a small tank of oxygen (HIS) and diffuser.

Would need to check with SSE if they would prefer remote download option rather than physical USB download facility.

Staffing

Would need three person team (1 tagger [RW], 1 anaesthetist [AS], 1 scribe). Assume tag 15th April- 15th May only as most efficient use of time and it takes a while for pike to 'switch on'.

Beauly
Fishery Board

Trap and truck study: Smolt numbers required per group to get statistically sound results

Power and Precision v4 software

Existing route return rate	Trucked return rate	Power	Smolt number per group
1%	5%	80-95%	285-470
2%	5%	80-95%	588-973
3%	5%	80-95%	1,506-2,493
4%	5%	80-95%	6,745-11,166
1%	4%	80-95%	424-701
2%	4%	80-95%	1,141-1,888
3%	4%	80-95%	5,301-8,775
1%	3%	80-95%	769-1271
2%	3%	80-95%	3,826-6,332
1%	2%	80-95%	2,319-3,837

2 tails (return Vs no return), alpha of 0.05.

Null hypothesis: There will be no difference in return rate between smolts that are released below the dams Vs those that run their usual route out of the catchment.