Jun 24th, 4:15 PM - 4:30 PM

Session E9: Migration of Atlantic Salmon (Salmo Salar) at Low-Head Archimedean Screw Hydropower Schemes

Robert Brackley
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Colin Bean
University of Glasgow; Scottish Natural Heritage

Rhian Thomas
University of Glasgow

Migration of Atlantic salmon at low-head Archimedean screw hydropower schemes

PhD student: Robert Brackley[†]
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[†] The University of Glasgow, [‡] Scottish Natural Heritage

Fish Passage Conference, Groningen
24 June 2015

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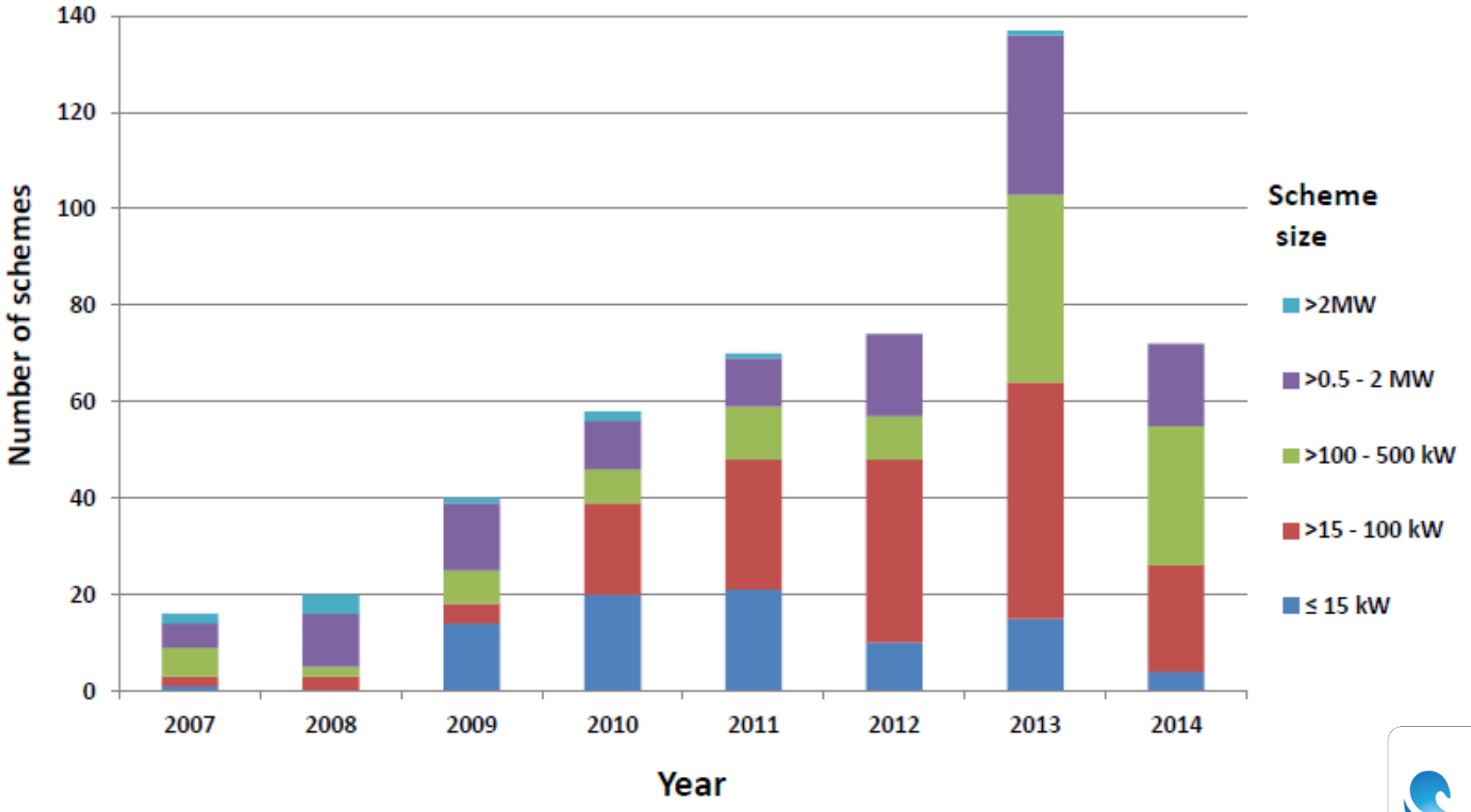
Small hydropower growth in Scotland

Schemes licensed over time



Courtesy of Richard Gosling and Ellie Willmott , SEPA Hydrology team

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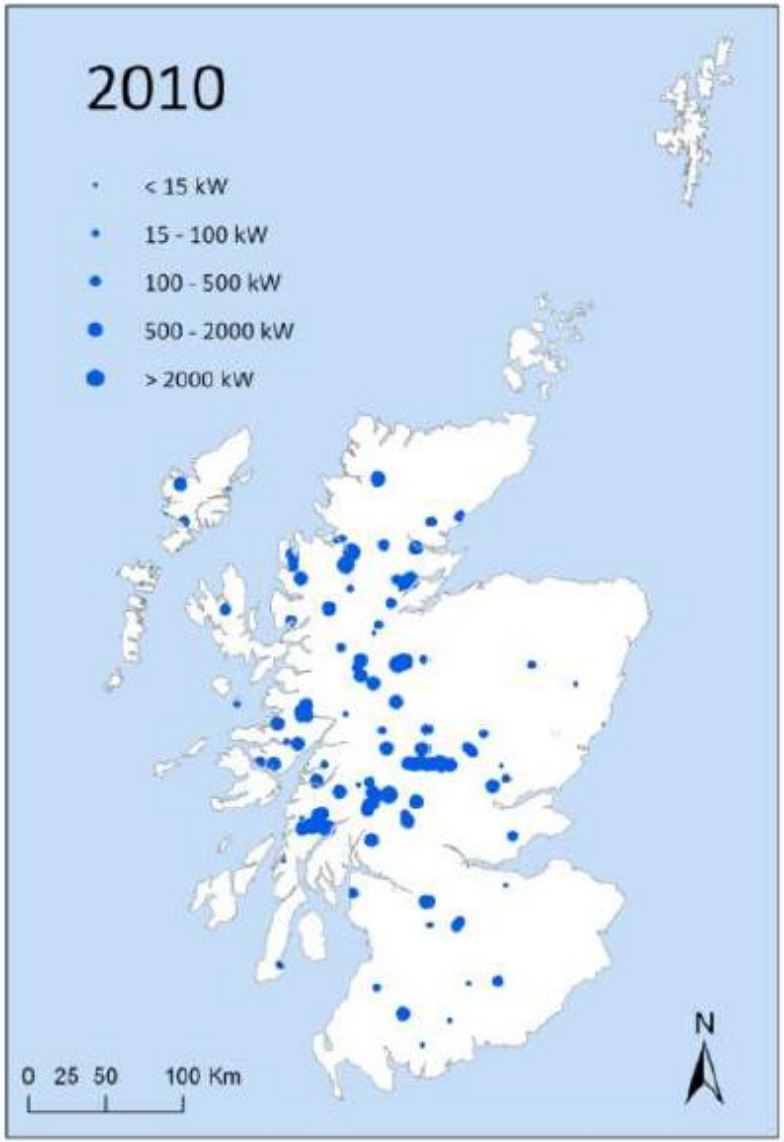

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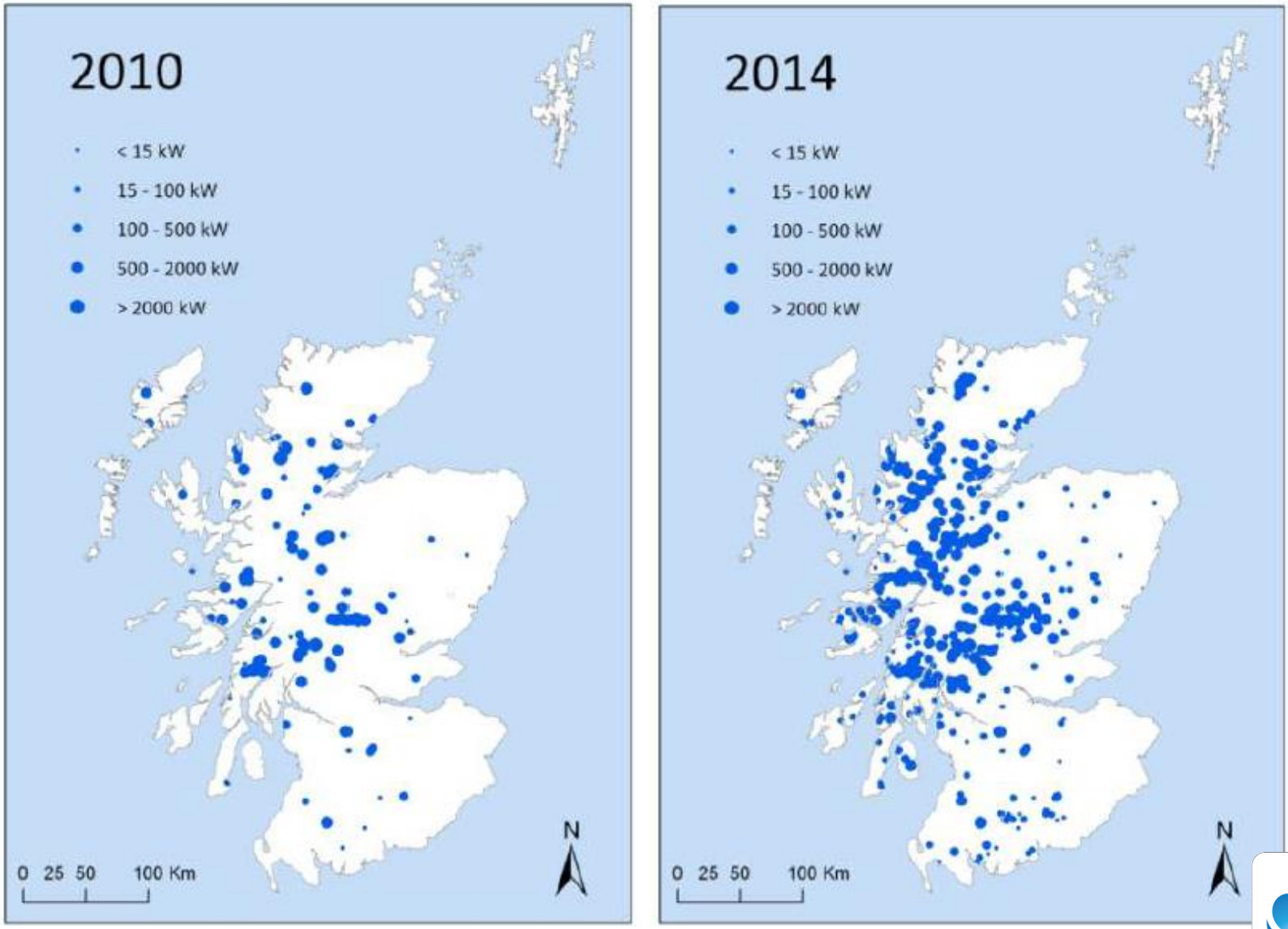

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Archimedean screw turbines

- Low head (>1m), high flow (0.6 - 6 cumecs)
- Diameters from 0.8 to 5m
- 2 to 5 blades
- Intake velocities: ~1m/s
- Maximum rotational speeds of ~ 30rpm

*E.A. Guidance for run of river hydropower (2013) ** SEPA Guidance for developers of run of river hydro (2014)

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4	2.2	30
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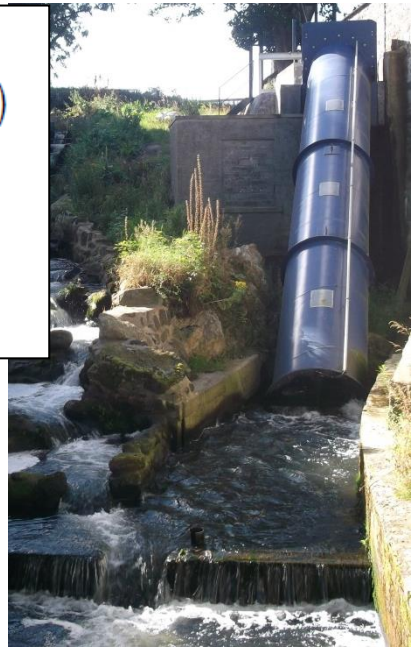
*



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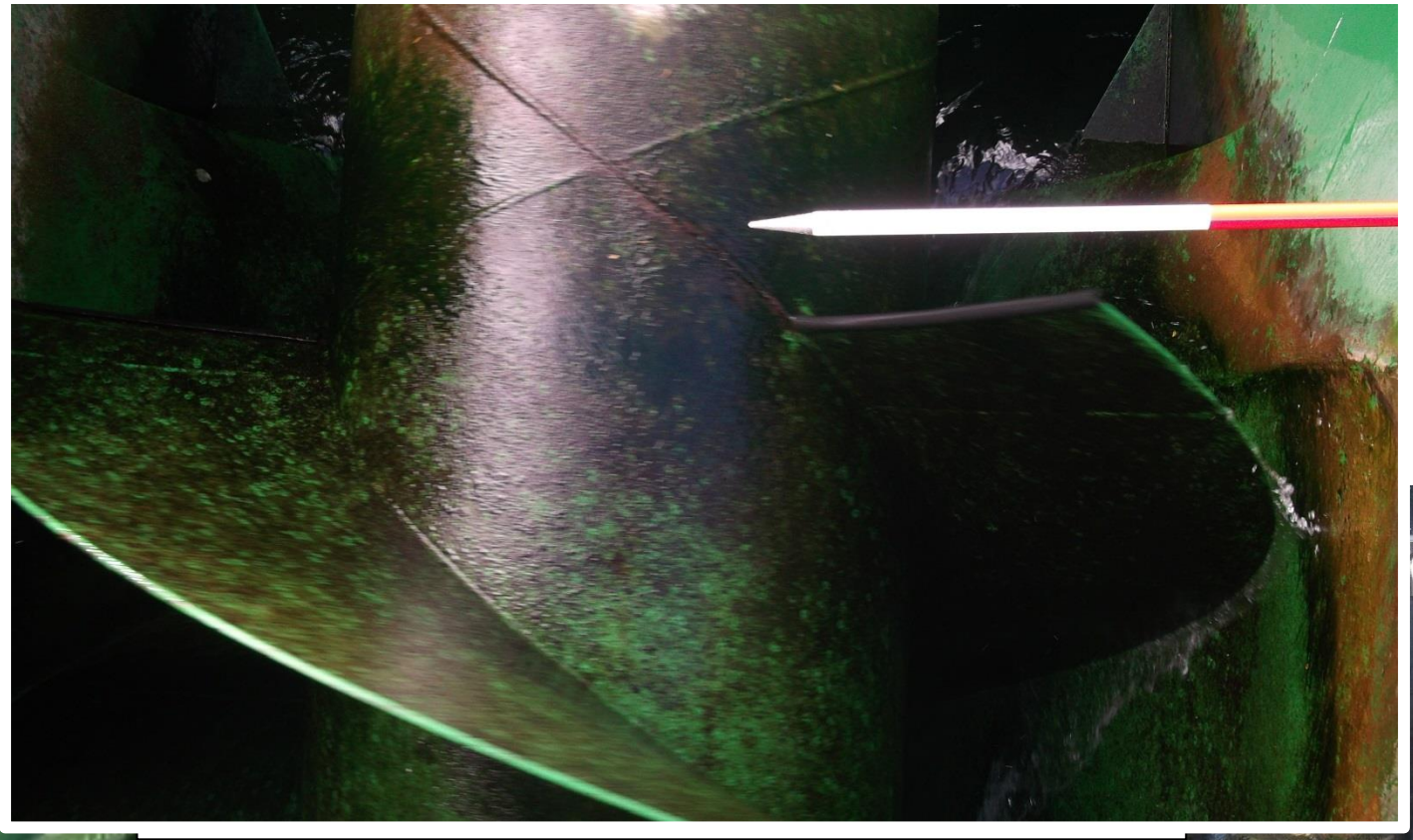

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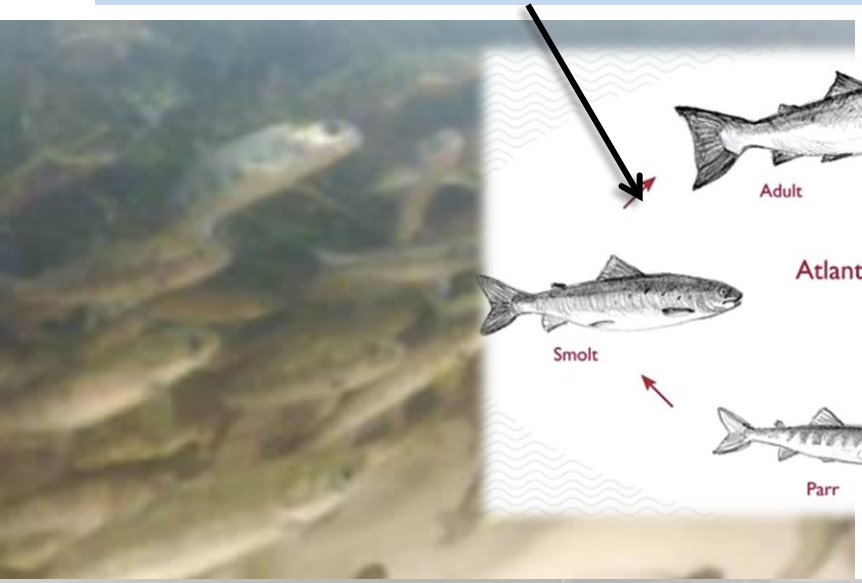
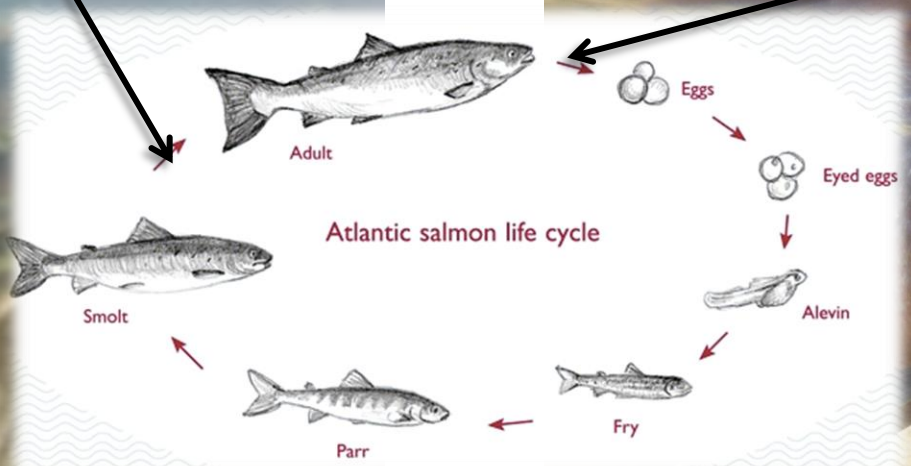
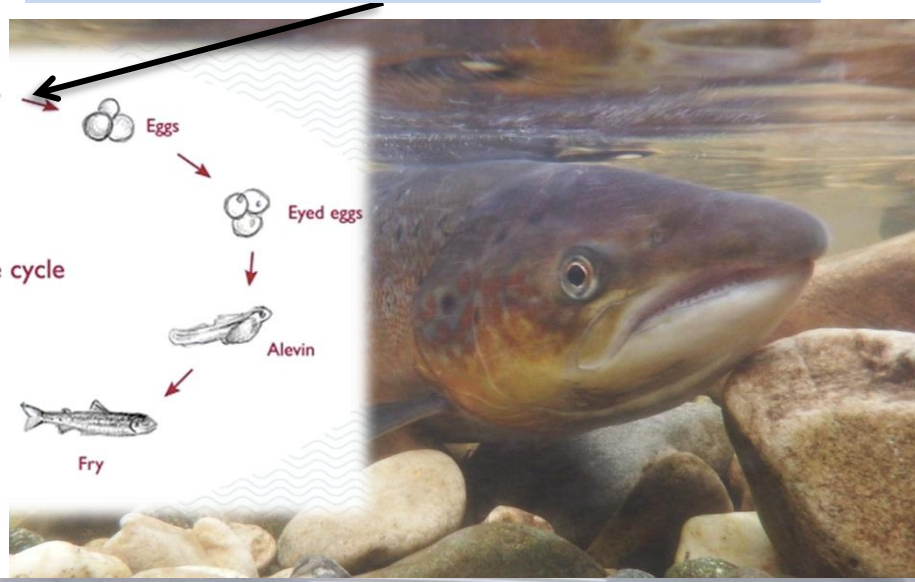
Investigating the risks to migrating salmonids

Smolt migration

Adult spawning migration





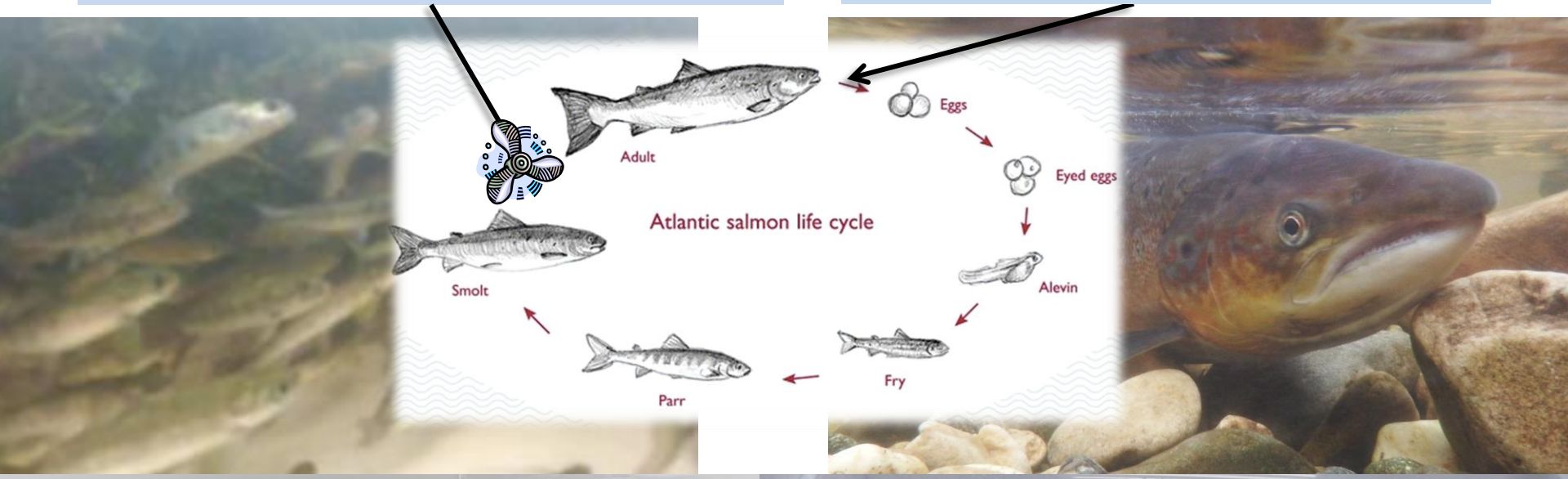


Investigating the risks to migrating salmonids

Smolt migration

- Risk of increased mortality from passage through ASTs

Adult spawning migration



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Timing of smolt sea entry may be critical due to availability of post-smolt prey, subsequent growth and predator avoidance.

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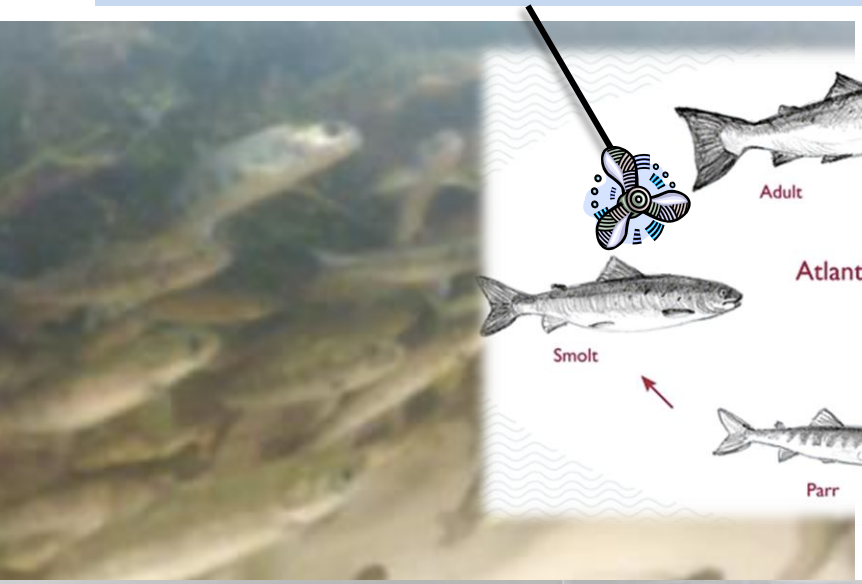

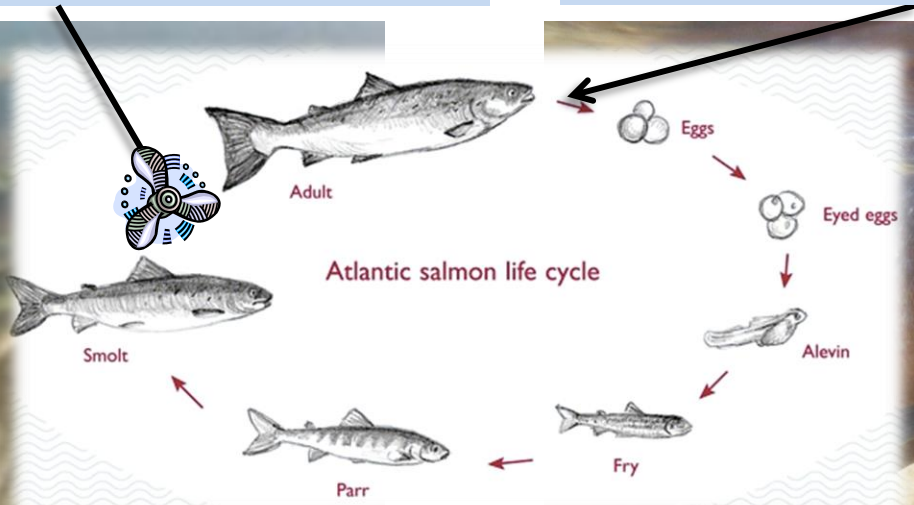

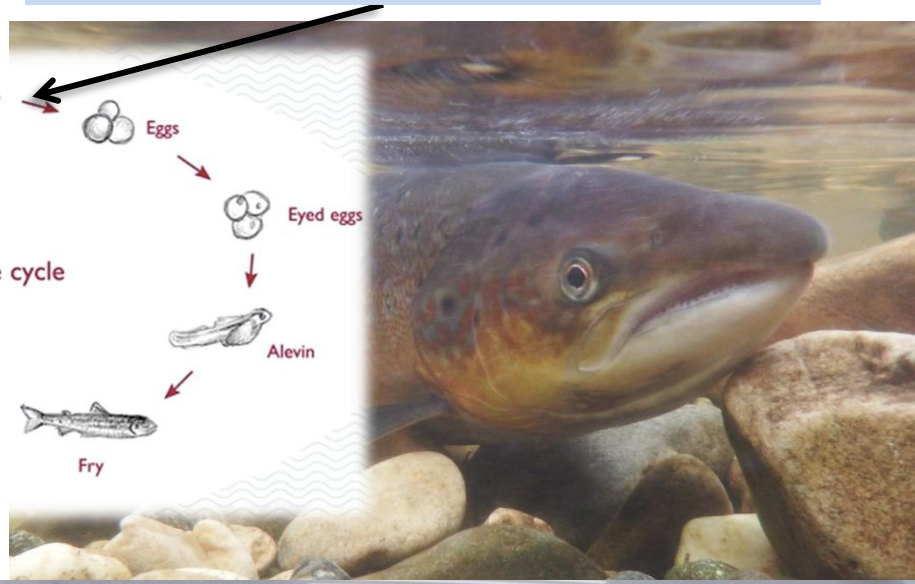

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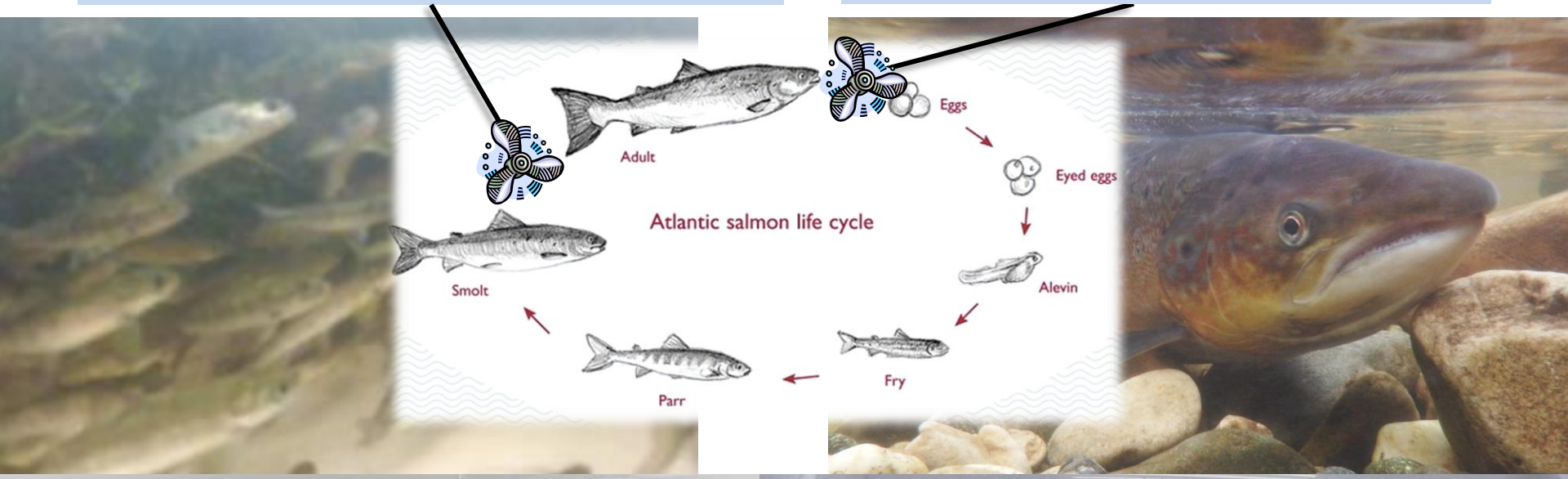
Adult spawning migration

- Delay/disruption by hydropower an important risk



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Timing of smolt sea entry may be critical due to availability of post-smolt prey, subsequent growth and predator avoidance.

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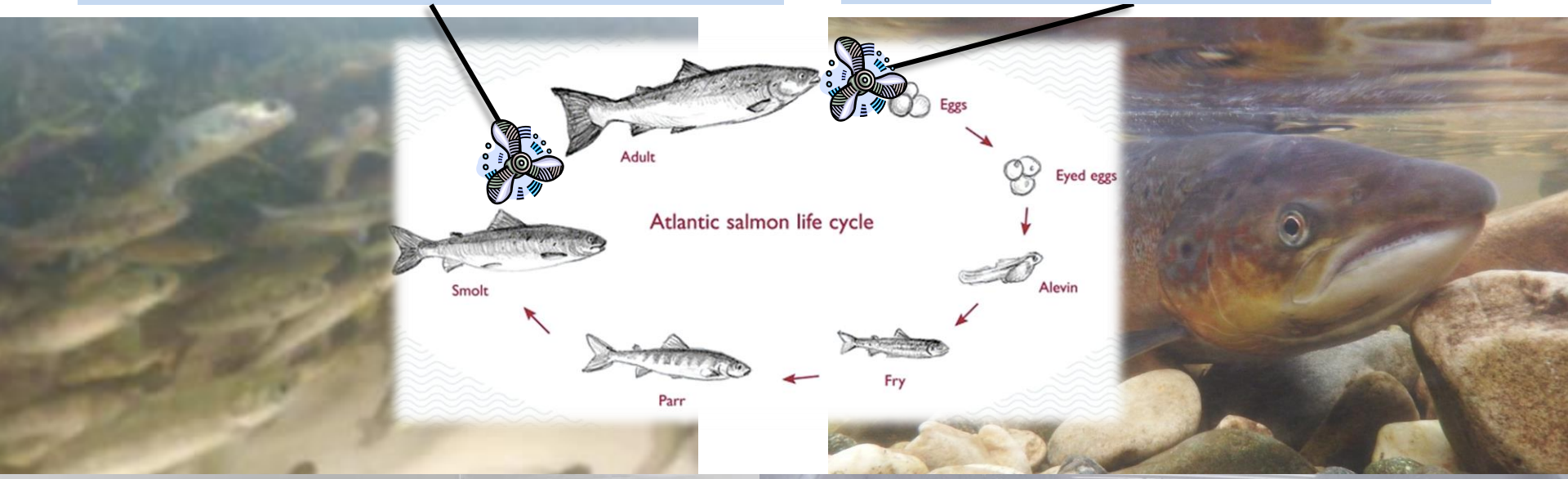
Adult spawning migration

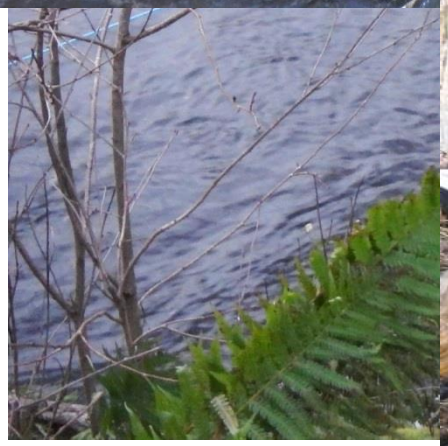
- Delay/disruption by hydropower an important risk

Repeat spawners can contribute to stability of population

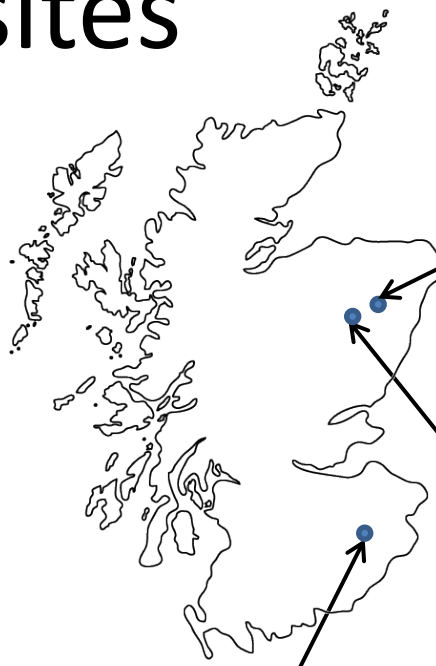
- Risk of increased mortality of post-spawned fish from hydropower passage



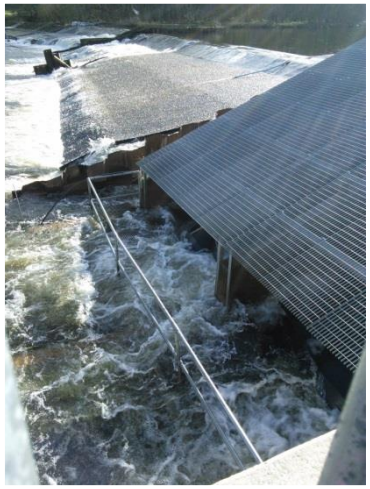
Methods used for monitoring fish movements near to hydro schemes

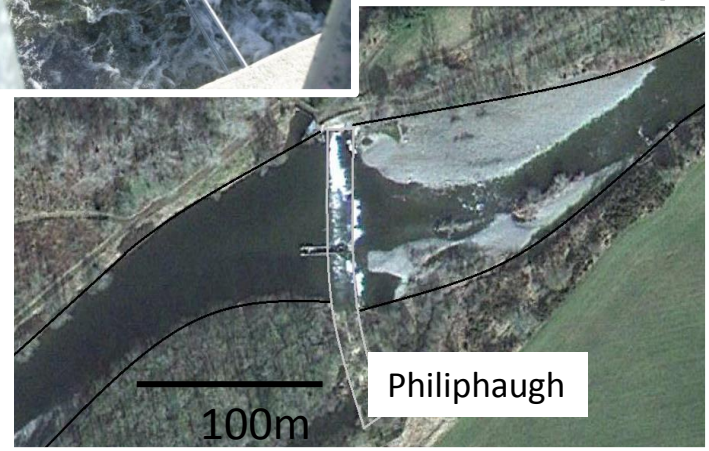


Study sites

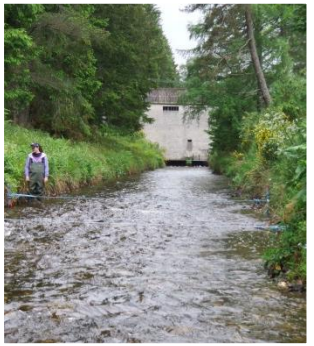


Craigpot
100m

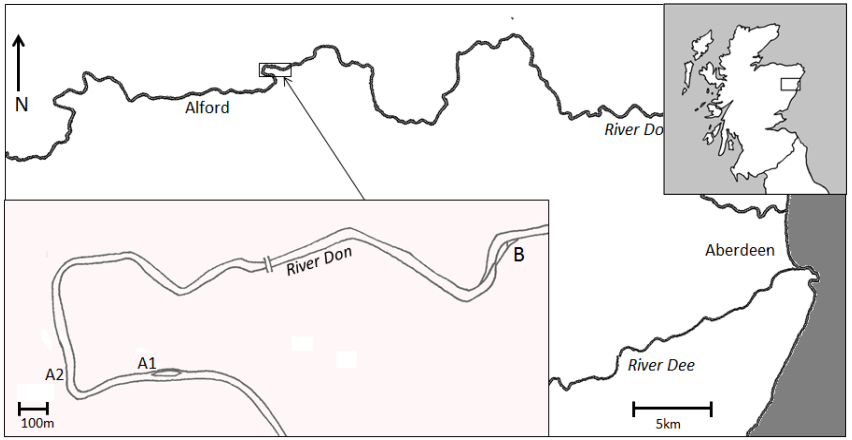


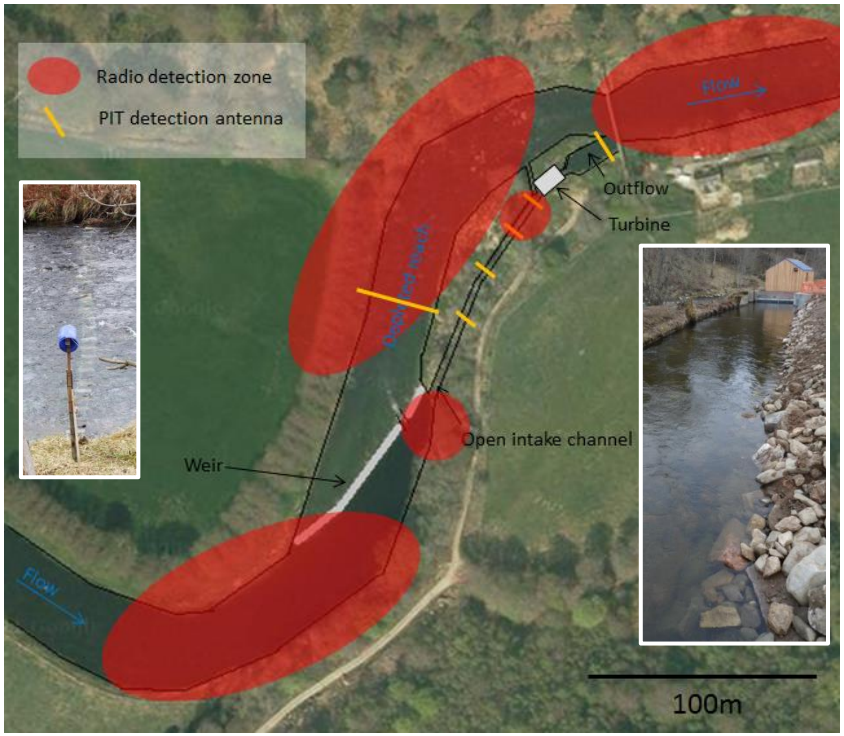

100m
Philiphaugh


Strathdon
A944
Turbine
Outflow
Intake
Receiver
250m
A2
A1
A4
350m
350m
130m
A3
Don
River Don
Weir + fish pass
100m
Depleted reach



Smolt tracking study 2013 + 2014

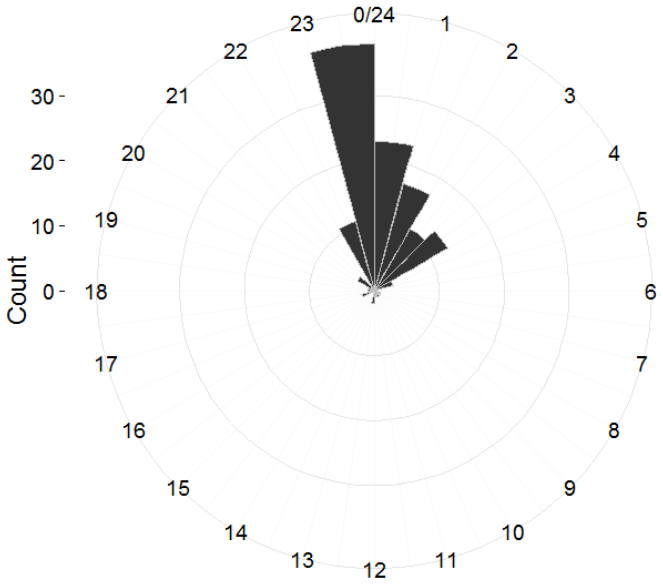




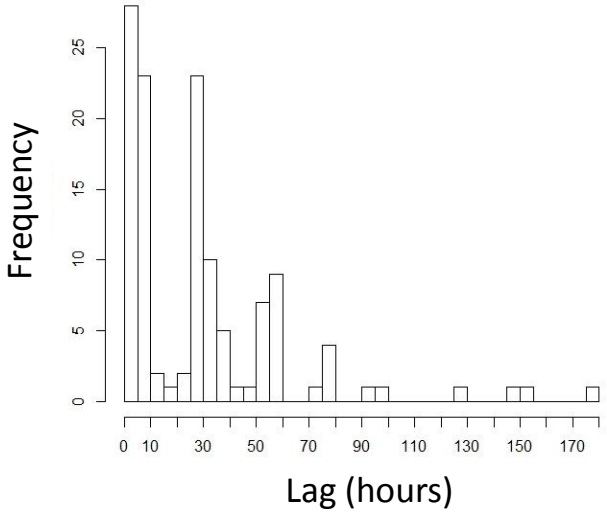
Smolt tracking results

- 27% of radio tagged salmon smolts passed through the turbine

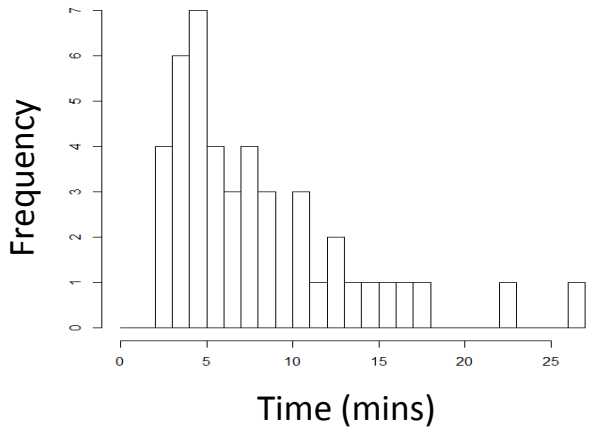
Diel timing of first detection



Migration lag between release and first detection



Time spent in turbine channel

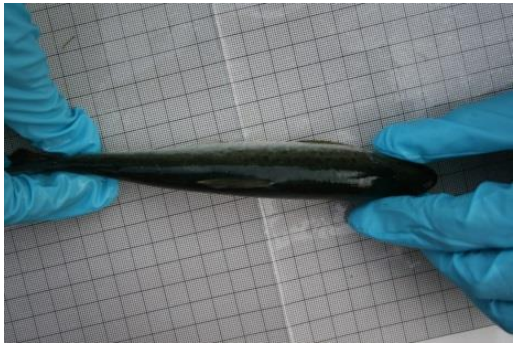


Salmon smolt turbine trials



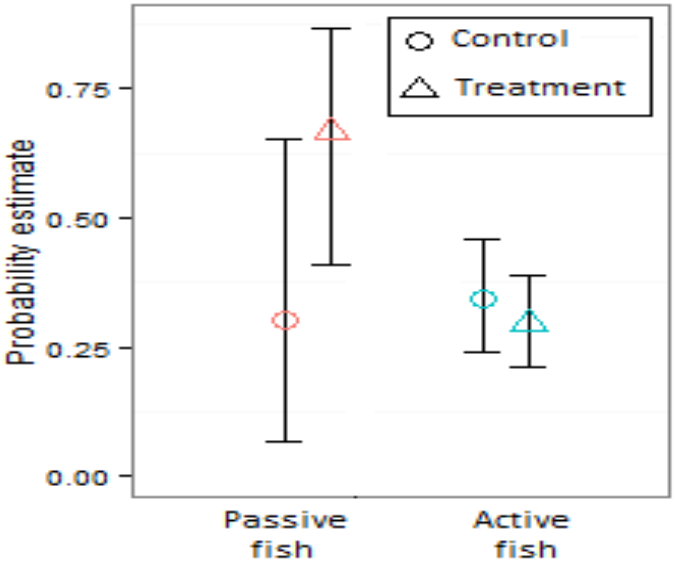




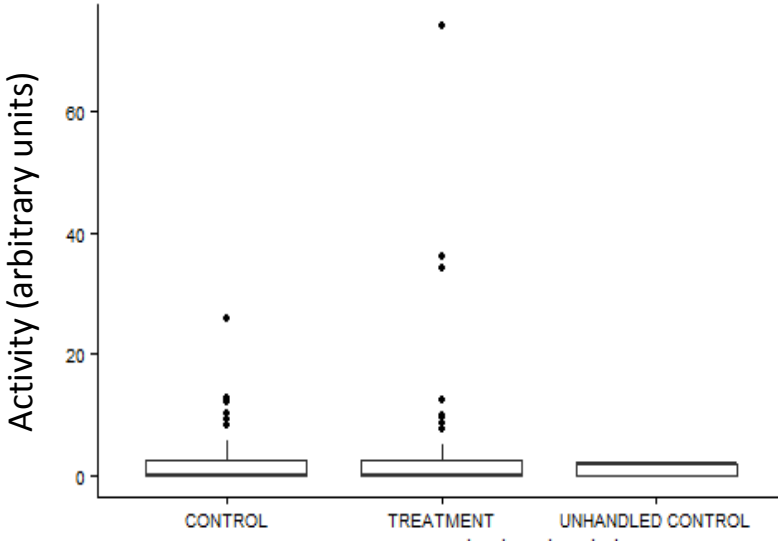



Salmon smolt turbine trials

Estimates for probability of scale-loss

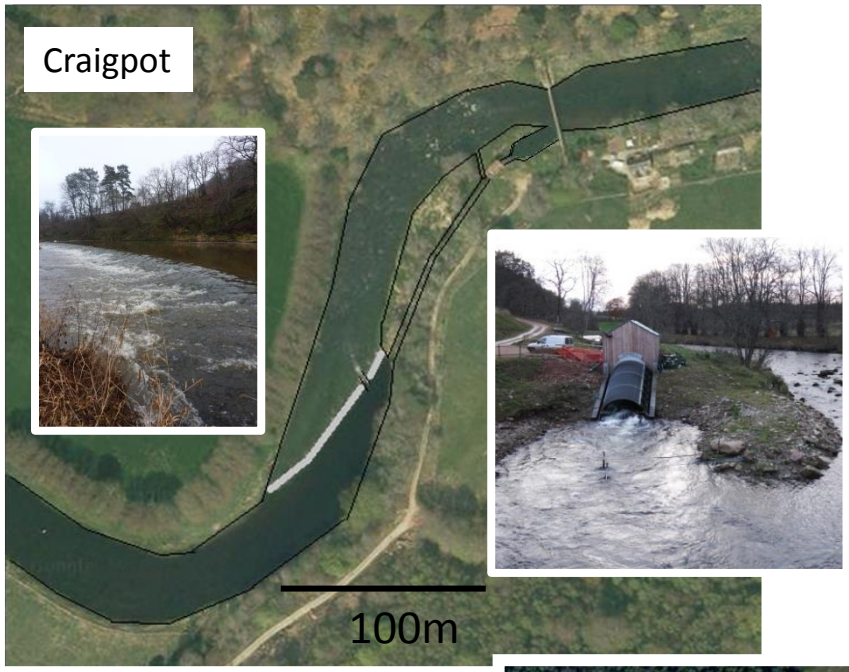


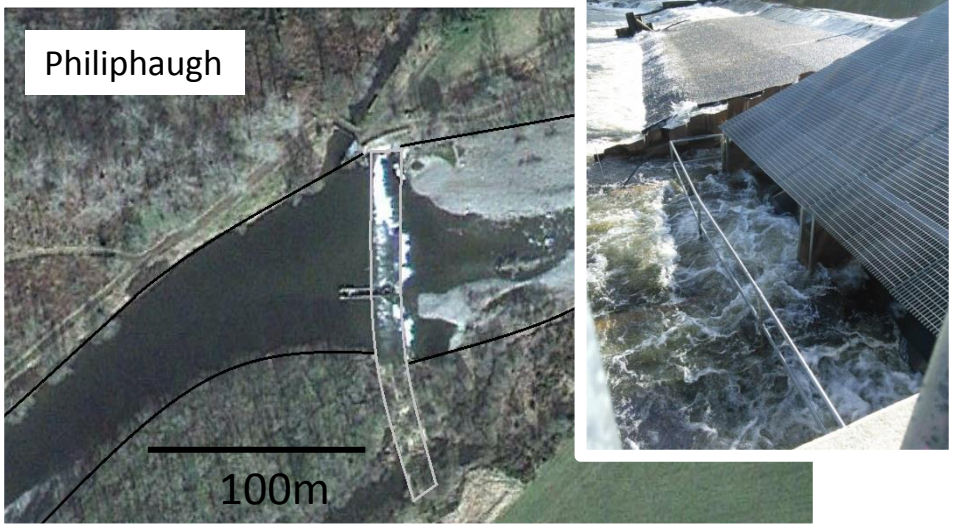
Enolase activity in blood serum*

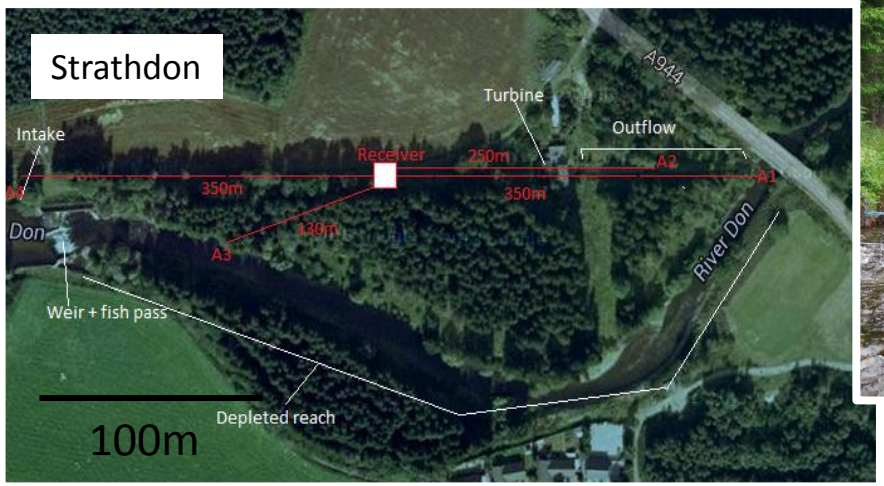


*Braceland et al. (2014). Serum enolase: a non-destructive biomarker of white skeletal myopathy during pancreas disease (PD) in Atlantic salmon *Salmo salar* L. Journal of Fish Diseases

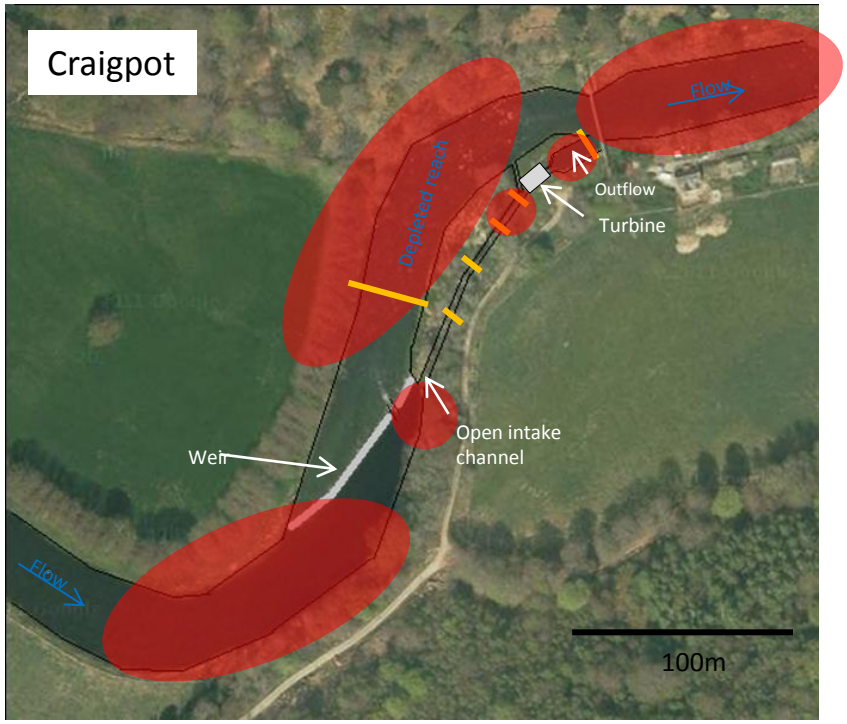
Monitoring adult passage at 3 distinctive hydro sites

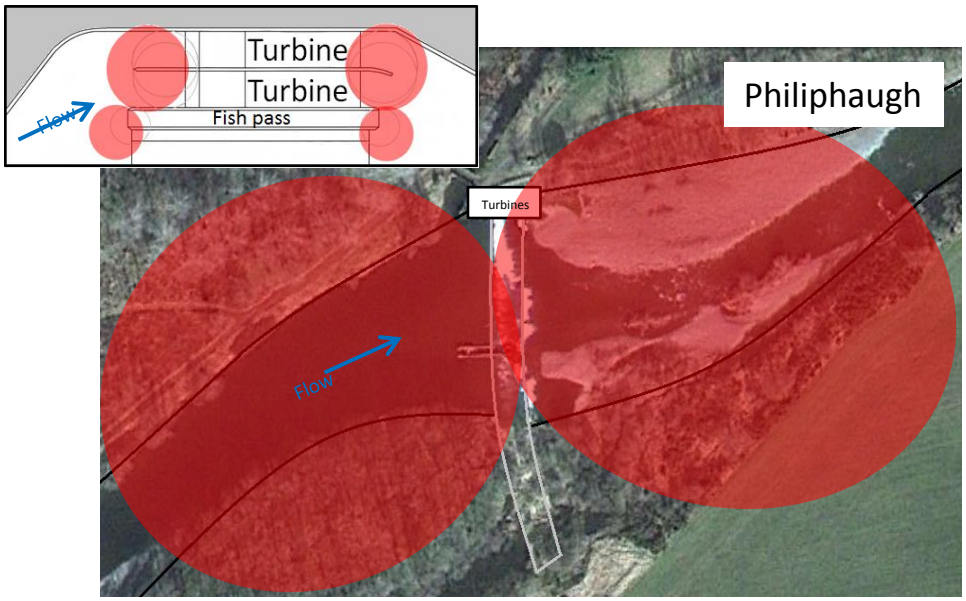


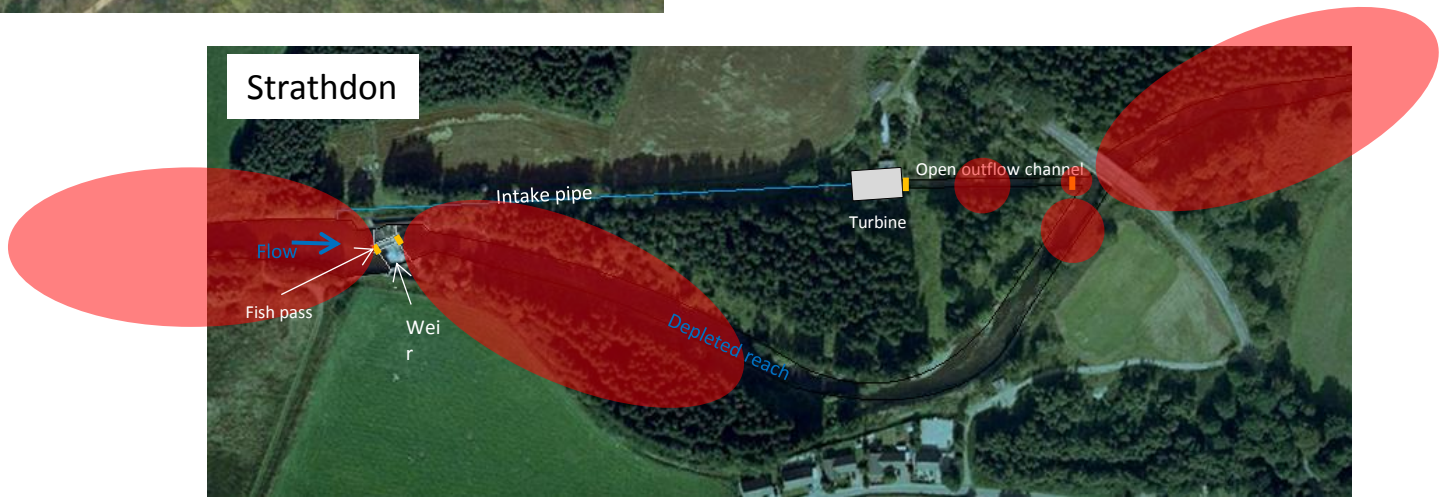




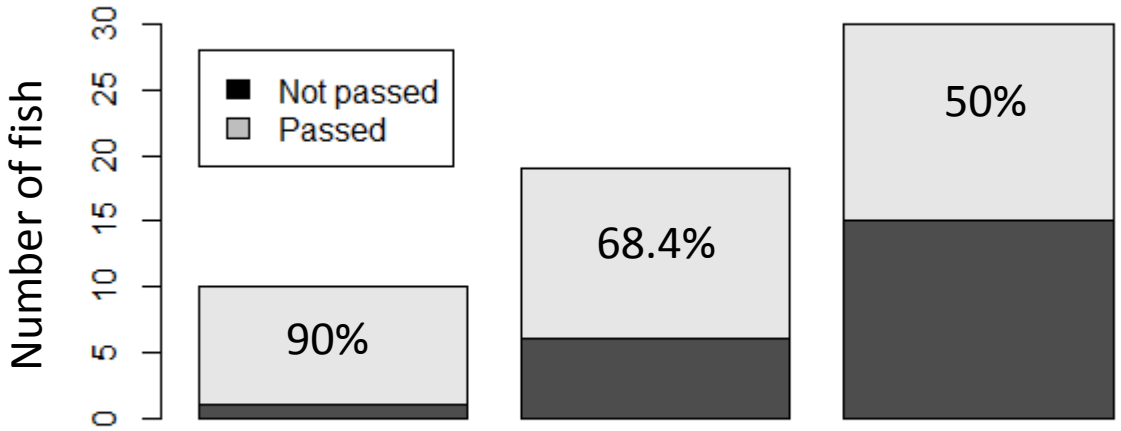
Monitoring layout

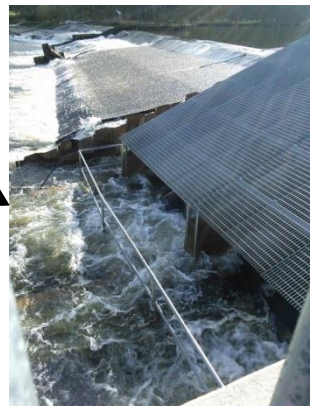






Adult passage success*

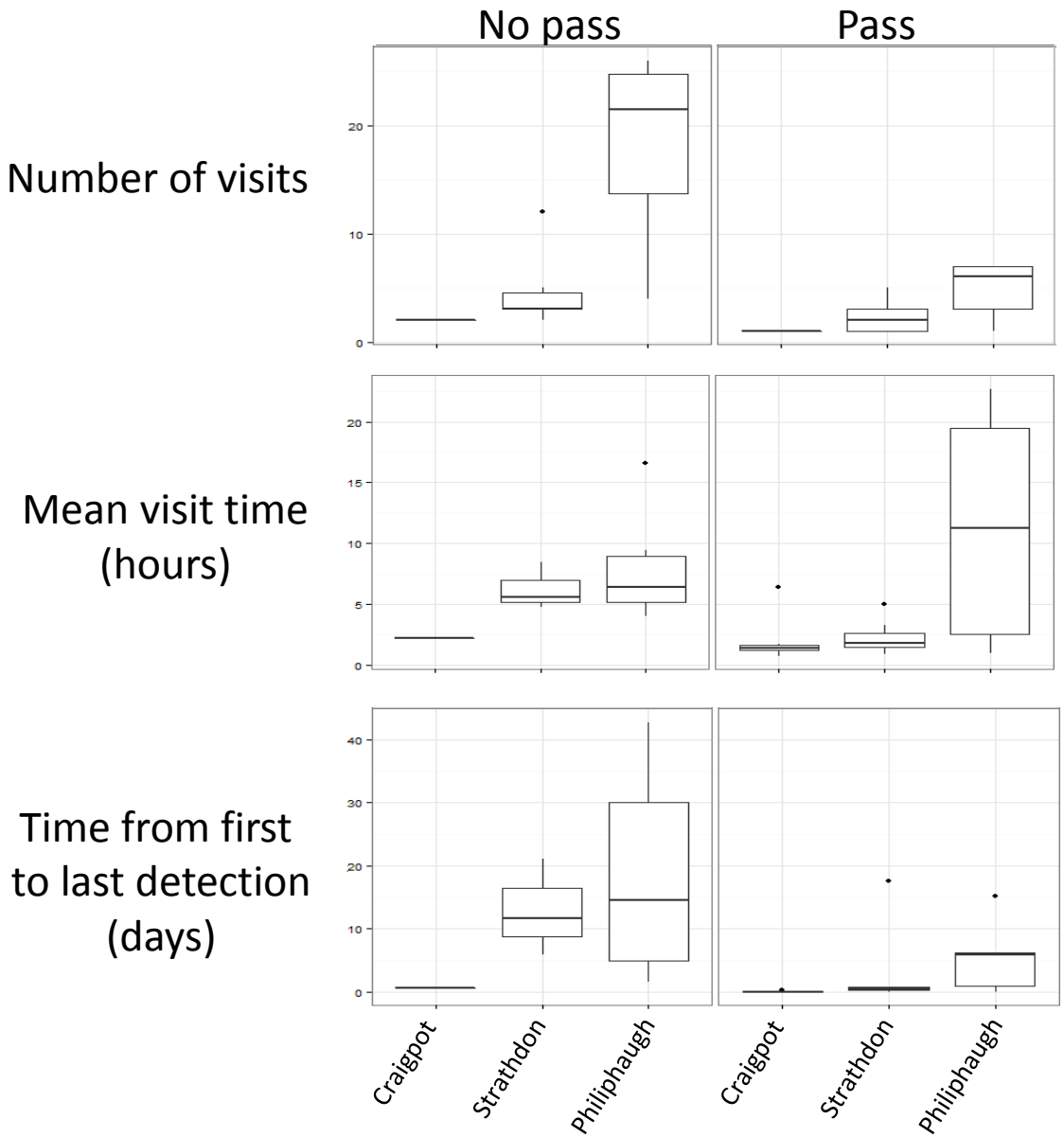


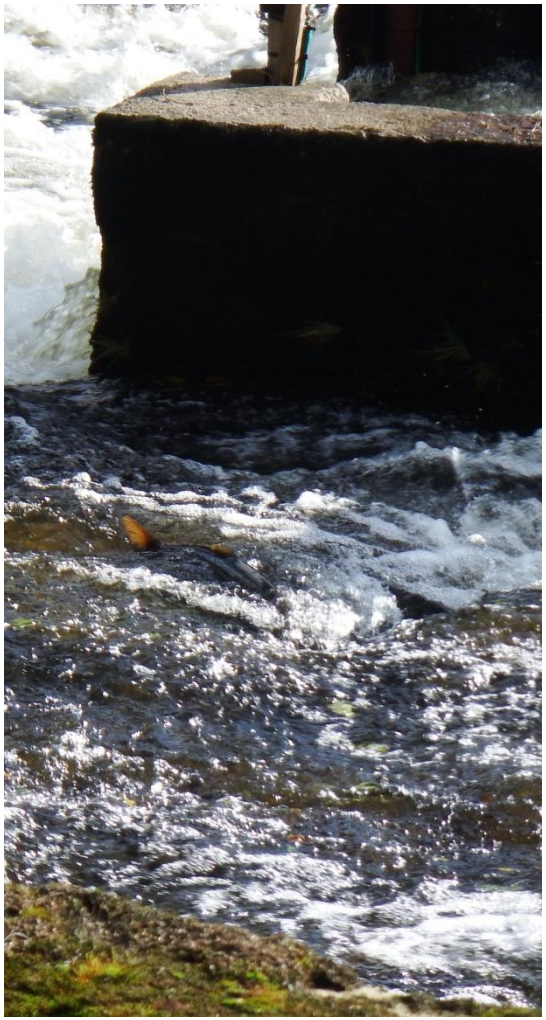


*Does not imply a hydro scheme-effect on non-ascending fish

Adult passage results

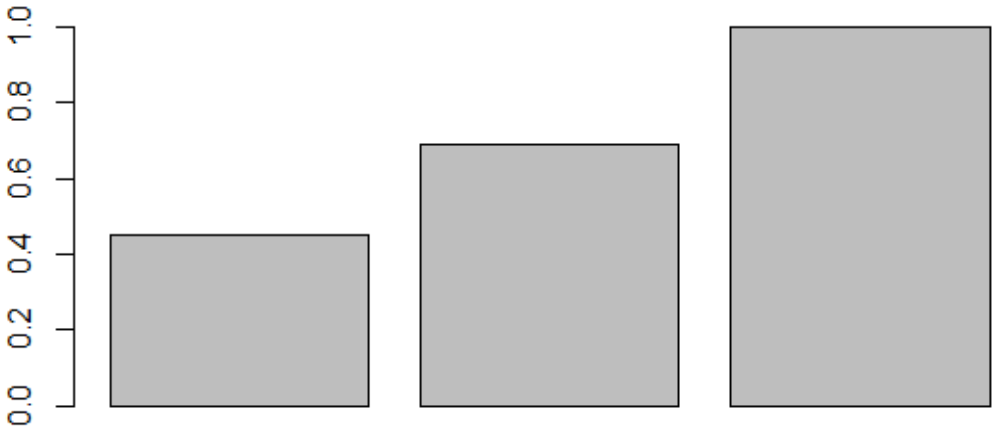
(preliminary)

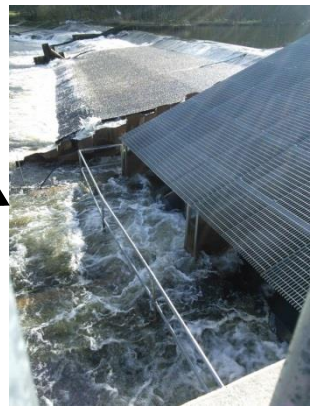




Outflow attraction

Proportion of fish which visited the turbine outflow





Conclusions and ongoing work

- **Smolt passage at Craigpot**
  - The proportion of naturally migrating tagged smolts which were exposed to turbine passage was 27%
  - Naturally migrating tagged smolts did not appear to be delayed at Craigpot under the observed conditions
  - Ongoing analysis to relate smolt passage route and behaviour to the abstraction rate and environmental variables
  - There was no apparent change in visible condition of turbine passed smolts relative to non-turbine passed smolts
  - Initial blood chemistry results indicate no bulk effect on turbine passed fish relative to non-turbine passed fish, though there may yet be a low prevalence of invisible damage
  - Further work will use additional analytes to explore potential impacts

- **Adult upstream passage at 3 distinctive low-head hydro schemes**
  - Passage success, complexity of movements and time at scheme is very variable and likely to be influenced by site location within catchment, site layout and hydrodynamics
  - Ongoing analysis to relate fine-scale behaviour to turbine operation and environmental variables

Acknowledgements

Mick Bestwick and Hydroshoal

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Kemnay Angling Club: Gordon Macdonald, Robbie Benzie, Marc Coull

Loch Lomond Fisheries Trust

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Jessica Monhart
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