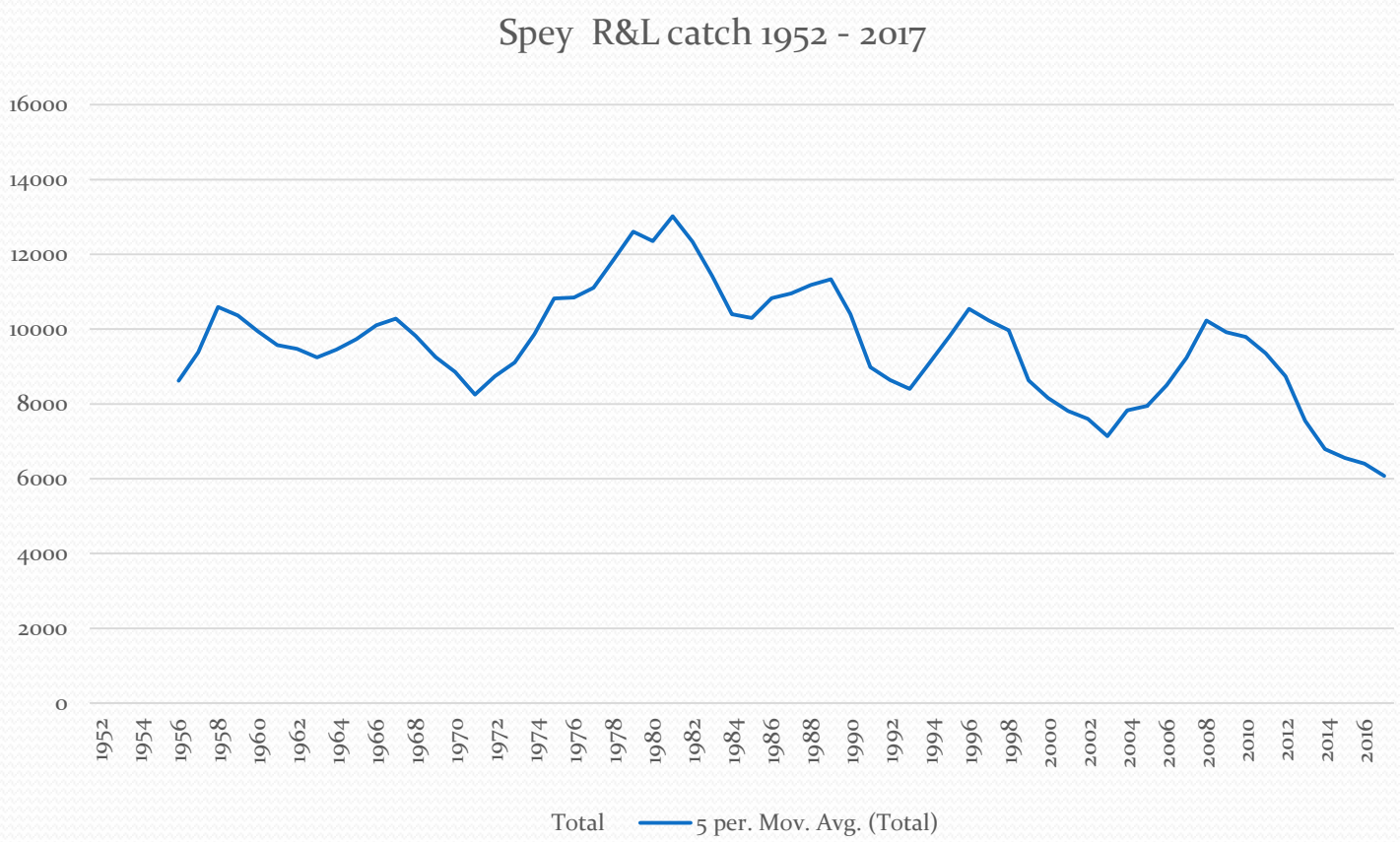
# *Spey Fishery Board Ghillies & Proprietors meeting*

Smolt rearing: a way forward for the Spey

Craigellachie 19th July 2018

# Catch data: Salmon



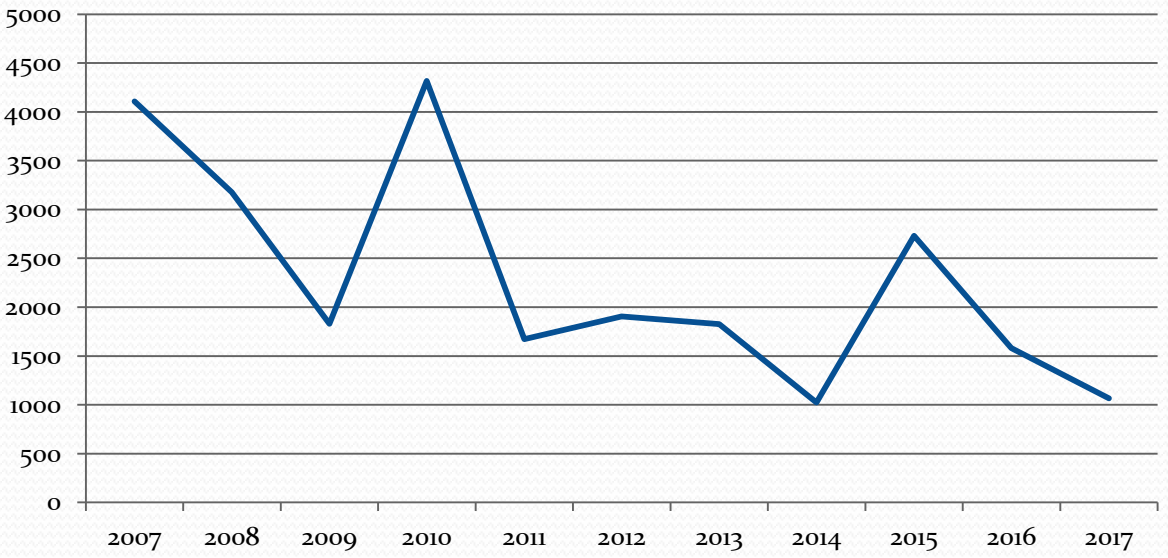
Salmon parr/min

| Location | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| Gordon Castle | 1.0 | 4.3 | 2.3 | 1.0 | 3.3 | 0.0 |
| Gordon Castle | 1.0 | 0.3 | 0.0 | 0.7 | 0.3 | 0.0 |
| Gordon Castle | 0.7 | 2.3 | 0.7 | 2.3 | 5.0 | 0.3 |
| Gordon Castle | 1.3 | 1.0 | 4.0 | 3.0 | 3.7 | 0.7 |
| Gordon Castle | 0.0 | 2.7 | 1.3 | 0.3 | 0.7 | 0.0 |
| Orton Water | 0.0 | 4.7 | 7.7 | 0.7 | 4.3 | 0.0 |
| Orton Water | 0.0 | 1.7 | 4.0 | 0.7 | 4.3 | 4.0 |
| Delfur | 1.7 | 2.0 | 4.0 | 0.0 | 6.3 | 0.0 |
| Delfur | 0.0 | 0.0 | 3.7 | 1.7 | 8.3 | 0.0 |
| Delfur | | 2.7 | 1.0 | 0.0 | 0.0 | 0.0 |
| Rothes | 1.3 | 7.0 | 1.7 | 2.0 | 7.0 | 0.7 |
| Rothes | 0.0 | 12.0 | 14.0 | 1.3 | 12.7 | 1.3 |
| Amdilly | 0.0 | 3.0 | 0.0 | 1.7 | 3.7 | 0.3 |
| Amdilly | 0.3 | 0.0 | 3.0 | 2.0 | 6.3 | 0.0 |
| East Elchies | 0.3 | 0.0 | 1.0 | 0.3 | 3.7 | 0.0 |
| Craigellachie | 0.7 | 4.0 | 2.0 | 0.3 | 2.0 | 0.7 |
| Craigellachie | 0.3 | 0.0 | 3.0 | 0.0 | 2.7 | 0.3 |
| Craigellachie | 1.0 | 6.7 | 9.7 | 0.7 | 8.0 | 3.3 |
| Aberlour | 2.0 | 35.7 | 19.7 | 1.3 | 18.7 | 14.3 |
| Kinermony | 0.7 | 3.0 | | | | |
| Wester Elchies | | 13.7 | 15.7 | 3.7 | 12.3 | 5.3 |
| Delagyle | 3.0 | 2.3 | | | | |
| Wester Elchies | | 5.7 | 3.3 | 2.3 | 3.3 | 0.3 |
| Laggan | 1.0 | 8.3 | 4.3 | 0.7 | 4.7 | 6.0 |
| Laggan | 0.7 | 3.3 | 1.3 | 0.0 | 7.7 | 2.0 |
| Carron | 1.7 | 2.0 | 6.3 | 1.3 | 3.0 | 6.0 |
| Knockando | 2.3 | 12.7 | 13.0 | 3.3 | 7.7 | 8.3 |
| Phones | | 5.3 | 6.3 | 0.0 | 3.7 | 5.3 |
| Lower Pitchroy | 4.7 | 9.7 | 9.7 | 1.7 | 11.7 | 10.3 |
| Ballindalloch | 1.7 | 2.3 | 11.0 | 2.3 | 6.0 | 8.7 |
| Ballindalloch | 1.3 | 5.0 | 4.7 | 2.3 | 3.0 | 8.3 |
| Tulchan D | 0.0 | 2.0 | 1.0 | 1.3 | 1.7 | 8.0 |
| Tulchan C | 4.0 | 8.0 | 7.7 | 5.3 | 10.3 | 9.0 |
| Tulchan B | 2.7 | 10.7 | 4.0 | 3.7 | 8.3 | 9.3 |
| Tulchan A | 2.3 | 1.7 | 1.3 | 2.7 | 5.0 | 5.7 |
| Castle Grant 3 | 10.0 | 7.0 | 6.7 | 3.0 | 5.0 | 5.3 |
| Castle Grant 2 | 0.7 | 0.7 | 1.0 | 1.3 | 4.7 | 0.7 |
| Castle Grant 1 | 1.0 | 0.0 | 2.0 | 1.3 | 1.3 | 2.7 |
| SAIA | 1.0 | 7.7 | 13.0 | 6.0 | 6.7 | 8.7 |
| SAIA | 1.3 | 8.3 | 11.3 | 5.0 | 5.3 | 2.3 |
| Abernethy AA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Abernethy AA | 0.0 | 1.7 | 0.3 | 0.7 | 1.0 | 0.3 |
| Kinchurdy | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 2.0 |
| Aviemore AA | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 0.0 |
| Kinrara | 0.0 | 0.7 | 0.0 | 0.7 | 0.0 | 0.0 |
| Kinrara | 0.0 | | | | | |
| Dalraddy | 1.0 | 0.0 | 0.0 | 0.3 | 1.0 | 0.0 |
| Badenoch Ruthven Bridge | 0.0 | 1.3 | 0.0 | | 0.0 | 1.7 |
| Badenoch Golf course | 1.0 | 4.0 | 0.0 | 1.3 | 1.7 | 2.7 |
| Badenoch Calder Mouth | 0.7 | 1.3 | 4.7 | 4.0 | 5.7 | 4.3 |
| Badenoch AA | | | | 1.3 | 4.0 | 2.3 |
| Truim | 4.7 | 4.0 | 2.3 | | | |
| Laggan | 1.0 | 3.3 | 0.3 | 0.3 | 2.7 | 3.3 |
| Laggan | 2.0 | 5.0 | 2.3 | 3.0 | 9.3 | 3.7 |
| Below Spey Dam | 4.7 | 11.3 | 7.0 | 7.0 | 10.3 | 2.3 |
| Glenshirra | 0.7 | 3.7 | 1.3 | 0.0 | 3.3 | 0.0 |
| Garvamore | 0.3 | 5.7 | 1.0 | 0.0 | 1.3 | 0.7 |
| Garva Bridge | 1.3 | 4.0 | 0.7 | 0.0 | 1.7 | 0.3 |
| Upper Spey | 0.0 | 0.7 | 0.0 | 0.0 | 0.3 | 0.0 |
| Upper Spey | 1.3 | 4.7 | 0.7 | 0.0 | 1.7 | 0.0 |
| Upper Spey | 0.0 | 3.3 | 0.7 | 0.0 | 1.3 | 0.0 |
| Upper Spey | 0.3 | 2.0 | 0.3 | 0.0 | 0.3 | 0.3 |
| Upper Spey | 1.0 | 1.0 | 0.0 | 0.0 | 0.7 | 0.0 |
| Upper Spey | 0.3 | 4.7 | 1.3 | 0.0 | 1.0 | 0.7 |
| Upper Spey | | | | 0.0 | 0.0 | 0.0 |
| Upper Spey | 0.3 | 0.7 | 0.0 | 0.0 | 0.3 | 0.3 |
| Upper Spey | 0.3 | | | | | |
| | 1.2 | 4.3 | 3.8 | 1.4 | 4.2 | 2.6 |

# Background: Spey data

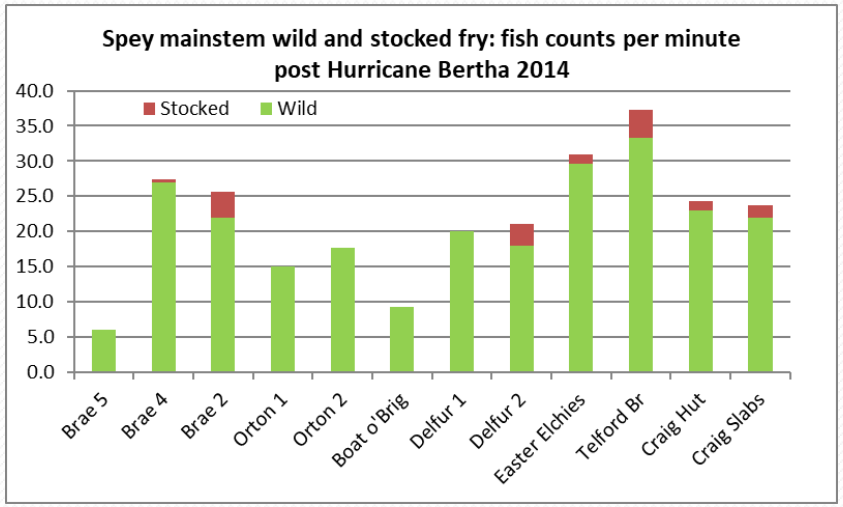
- Two sea winter run of 2018 is weak, UK-wide, perhaps even internationally
- 2016 smolt run derived from the 2015 parr counts, which were low.
- 2017 grilse catch was low – same across Scotland. Spey 2014 grilse catch was similar
- Prospects for 2018 were not good
- Compounded by marine factors

**Spey grilse catch**



# Spey stocking policy

- The Spey has long embraced stocking
- Current policy is (largely) mitigation stocking:
  - Primarily to address impacts of man-made barriers e.g. at distillery intakes, road culverts etc
  - These barriers represent 0.64% of the total accessible area
  - Impact of impassable barriers declining due to fish pass improvements e.g. Knockando Burn
- Hatchery has been used to mitigate against extreme climatic events, although effects were limited
- Genetic study suggested impact on catches was small



# Smolt rearing: SWOT analysis

**Strengths**

- "Seen to be doing something"
- Brings the river together?
- Marketing opportunity
- Increased catches
- Improve viability/sustainability of fishery
- Minimise ecological risks to wild stock
- The Petition

**Weaknesses**

- Reputational damage: "put and take" rather than wild fishery
- Practicalities of smolt rearing*
- Stocking application process*
- Scientific consensus against
- Lack of unified position
- Low returns of adult fish
- Failure to identify returning fish

Threats

- Genetic risk to wild stock - "Additional burden on the population"*
- Fish health - fungus
- Fail to address main reasons for decline
- Catastrophic loss in hatchery
- Inability to capture appropriate broodstock
- Increased operating costs
- National review of stocking
- Create predation hotspot(s)

Opportunities

- Research viability of smolt stocking
- Incorporate advances in smolt rearing techniques
- Compare in-river survival/migration of reared and wild smolts
- Investment in hatchery infrastructure
- Produce larger smolts

# Smolt rearing: Genetic concerns

**Genetic risk to wild stock: effectively an additional burden on the population**

Hatchery fish:

- Exhibit lower survival
- Have lower reproductive success
- Have reduced genetic variation (Araki & Schmid, 2010)

Early generation hatchery fish averaged half the reproductive success of wild origin counterparts

Reductions in reproductive success in these systems occurred during spawning or early juvenile rearing (as opposed to offspring survival after migration out to the ocean; (Christie et al, 2014)

The higher the proportion of ranched eggs in the Burrishoole salmon spawning population the lower the production of smolts (McGinnity et al, 2009)

Number of offspring produced by hatchery origin Atlantic salmon was nearly half that of wild-born fish (0.55). (Miliot et al., 2013)

# *Smolt rearing: Genetic concerns, cont'd.*

Mechanisms for fitness decline:

- Survival of harmful mutations in hatchery
- Inbreeding depression due to small pool of broodstock
- Domestication selection – fish that do well in the hatchery not suited to wild (Araki et al,. 2008)

Harmful changes occur within one or two generations, and are impossible to prevent (Chilcote et al., 2011)

Epigenetic effects*: active against inactive genes

- Some genes are downregulated, or less expressed, most likely, in the hatchery fish relative to wild fish
- Including "genes for immunity, the transmission of neural signals to muscles for locomotion, and appetite and feeding behaviours" (The Scientist, May 2018)

"Epigenetic reprogramming caused by environmental conditions at a specific time that may induce phenotypic changes which may persist in subsequent life stages" (Le Luyer et al., 2017)

* Epigenetics is the study of heritable changes in gene expression (active versus inactive genes) that do not involve changes to the underlying DNA sequence — a change characteristics without a change in genotype — which in turn affects how cells read the genes.

# *Smolt rearing: practicalities.*

- Most hatchery practitioners consider that parr have to be **10g** at the end of September for the production of one year old smolts.
- At present our hatchery parr typically average 2 to 3g at that time of year.
- Without change to operating and management regime we would be unable to produce any significant numbers of one year old smolts.
- Production of two year old smolts requires double hatchery capacity and is fraught with challenges relating to precocious parr and fungus.
- One year old smolts are produced on the Delphi and by Jon Gibb (Lochaber). These hatcheries are at sea level and subject to mild Atlantic temperatures.
- Sandbank hatchery was not set up to rear smolts, nor the Tulchan hatchery
- Investment would be required to upgrade infrastructure for smolt rearing:
  - Increased water supply
  - Larger tanks
  - Heated water, or recirculation
  - Lighting control/automatic feeders/grading equipment
  - Tagging

# Summary

- Spey catches, like other rivers, are in decline
- Main change has been the reduction in the grilse catch
- Iceland trip was very informative
- Smolt ranching is quite restricted in Iceland – a few rivers rely on it almost 100% - they have no natural spawning.
- Targeted smolt ranching used in a few other rivers.
- On rivers other than the East & West Ranga, smolt stocking is done against the advice of the regulators
- The majority of rivers in Iceland rely on natural spawning.
- Catches in Iceland are stable.
- Smolt ranching provides opportunities but need to be balanced against risks
- There is no evidence that smolt ranching restores populations.
- The genetic risks outlined show that wild stocks would be weakened by smolt stocking, and therefore, less able to sustain themselves.
- The SAC status of the Spey limits what can be done with stocking