FAMILY AND PLOIDY EFFECTS ON HATCHERY SURVIVAL, DEFORMITIES, AND PERFORMANCE IN ATLANTIC SALMON

J.F. Taylor1*, H. Migaud1, A.C. Preston1, J. Bron1, John Taggart1 & D. Guy2

1 Institute of Aquaculture, University of Stirling, Stirling, Scotland, UK.
2 Landcatch Natural Selection, Alloa, Scotland, UK.
Current problems in salmon farming

Genetic pollution by escapes
– Reduced fitness of wild population
– Reduced spawning (due to increased competition)
– Spread disease and parasite (ISA, BKD, IPN and Sea lice)

Is Triploidy the solution?
• Tested in early 1990’s to prevent maturation
• Abandoned in favour of photoperiod control

• Phenotypically similar, altered physiology?
  • Somatic growth- less/equal/high
  • Survival - lower
  • Deformity - greater
  • Flesh quality- similar to diploid
• Disease and stress resistance - comparable
• Environmental tolerance - triploid less tolerant

Industry is now keen to investigate this avenue again
SALMOTRIP: Feasibility study of triploid salmon production

FP6: EC Capacities Program (Jul 08 - Dec 10)
http://www.salmotrip.stir.ac.uk

5 Key areas of Research:

- Family-ploidy performance
- Culture sensitivity & deformity
- Out-of-season smolt production
- Commercial scale field trials
- Market Perception

Industrial partners in UK, Norway and France
1) Experimental Trials
- 10 full-sib families (2 year Class) 10♂:10♀
- 1st week December 2007, 2008
- Pressure induction (2500eggs/ploidy/family)
  - 9500PSI 5mins 30mins PF @ 10°C
- Individual family rearing : Ploidy Discrete
- Incubation: temp control 7.5 ± 0.8 °C
- Ongrowing: river water 12 ± 2.3 °C
- 1st feeding: Constant light & 24 hour feed

2) Commercial Trial (2008 only)
- 45 (full & half-sib) families 15♂:45♀
- 500 eggs / family / ploidy
- Communal family rearing: Ploidy discrete
- Incubation / ongrowing: river supply 10 ± 4 °C
- 1st feeding: Constant light & 24 hour feed
Sampling Procedure

- Oocyte diameter (no correlation to fertilisation)
- Daily egg picking / mortalities ~ survival
- Daily counting / classification deformity from hatch
- 1-2 weeks Wt-L measurement (n=20-50)

Ploidy Verification

- Flow cytometry & blood smears (n=100-200)
- 100% triploid rate
Survival to Hatch

- No overall ploidy effect on survival
- Significant family effect on survival
- Correlation between gamete quality and survival

Taylor et al., 2009
Diploid
Fertilisation Emryogenesis
Eyeing Pre-Shock Eyed Stage Post-Shock Hatch

Triploid
Fertilisation Emryogenesis Eyeing Pre-Shock Eyed Stage Post-Shock Hatch

Taylor et al., 2009
• No ploidy effect
• Significant family effect

Taylor et al., 2009
• Triploids significant smaller at hatch/first feeding
• Triploids higher SGR: comparable or higher weight at stocking
• Comparable mortality 2%
• Comparable deformity 4%
• Significant family effect on size at hatch and growth
• Higher SGR
• Lower deformity 50 vs 75%: Opercular shortening; environment vs. genetic?
Post-Hatchery Growth

Out-of-Season Smolt Regime (S0+)

- Triploids higher SGR
- Survival 98-99%
- Significant family effect
- Deformity <4%

Taylor et al., 2009
Conclusions

- **Triploids:**
  - Comparable survival
  - Lower hatch weight
  - Higher SGR during hatchery rearing
  - Comparable deformity prevalence
  - Strong *family* component
  - Optimal *gamete quality* essential
  - **Differential gene expression**
    - Life stage specific

- Future of triploid salmon looks promising
- Will be essential to monitor long-term performance
Future Directions

- Future work to focus on:
  - Family selection programs
  - Nutritional aspects
  - Immune function
  - Physiology & Endocrine function
  - Molecular mechanisms

- SALMOTRIP
  - Many components examined
  - Knowledge transfer to industry
  - Protect wild fisheries
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