Underyearling production strategies

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Time is money

- Present situation:
  - Of the 200+ mill smolts per year in Norway, 30-50% are underyearlings (0+)
  - Expected to increase
- Pressure towards early seawater transfer
  - Oktober >>august ?
- Pressure towards bigger smolts
- The time table doesn't add up!

Time conflict

- First feeding to start photomanipulation: 5 months?
- Photomanipulation to seawater transfer: 3 months?

- Size recommendation, vaccination: > 40g?
- Temperature recommendation, vaccination:

- Early egg delivery?
- Is it possible to cut some corners?
- What are the consequences?

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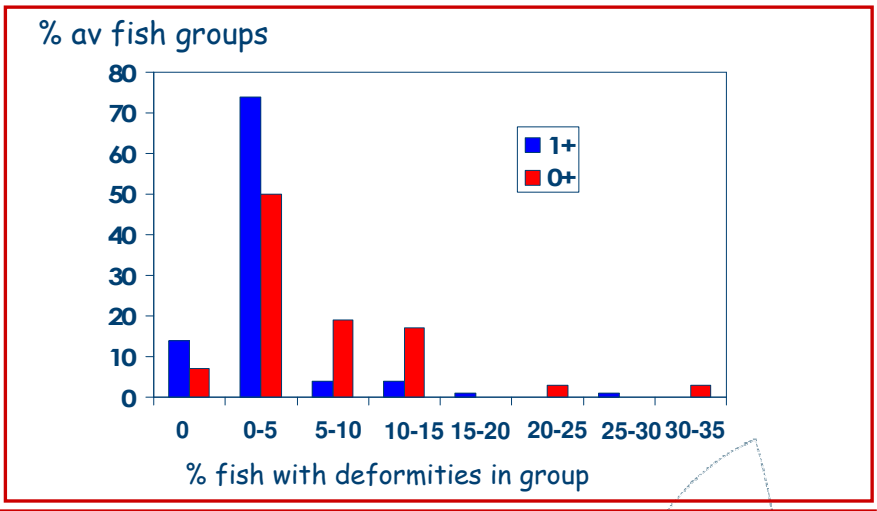
Prevalence of deformities

Field data, commercial farms, mid-Norway 2003



1+: **3,2%** of fish with recorded deformities at 1,5-2 kg
88% of groups had <5% fish with deformities

0+: **6,5%** of fish with recorded deformities at 1,5-2 kg
57% of groups had <5% fish with deformities

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”The underyearling project”

- Project objectives
  - To identify risk factors for deformities in production of underyearlings
  - To study cardiac development as well as skeletal development
    - Observations of small and rounded or abnormally shaped hearts in large fish

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Exp. 1 Temperature in parr stage

- Temperature in parr stage
  - Temperature recommendations of 12°C from first feeding and throughout juvenile stage
  - Pressure from producers: What about 13°C? 13,5°C? 14°C?
- Experiment
  - 12°C, 13°C or 14°C from first feeding to start photomanipulation (20g)
  - Common rearing at 12°C through photomanipulation, seawater period in common cage
- Not conclusive, 12>13<14 °C
- Some potential sources of error

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Time is money, but how much can be gained by increasing temperature?

- Calculations done based on Skrettings Club-N growth tables
- In Nofima Sunndalsøra, we predict growth within +/- a few days with these tables
- From 0,2 to 20g:
  - 12°C 18 weeks
  - 13°C 16-17 weeks
  - 14°C 15 weeks
- The BIG difference:
  - At 14°C, the fish get a quick start, but slow down later
  - At 12°C, the fish starts slower, but maintain a steady speed
- Is it worth the risk?

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Exp 2 Temperature during smoltification

- What are the effects of high temperatures during photomanipulation and smoltification?
- Especially relevant in underyearling production:
  - Winter signal (12D:12L) will normally occur during summer when natural temperatures are high

12D:12L	24L
12°C	12°C
16°C	16°C
12°C	16°C
16°C	12°C

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12D:12L \ 24L	12°C	16°C
12°C	12-12	12-16
16°C	16-12	16-16

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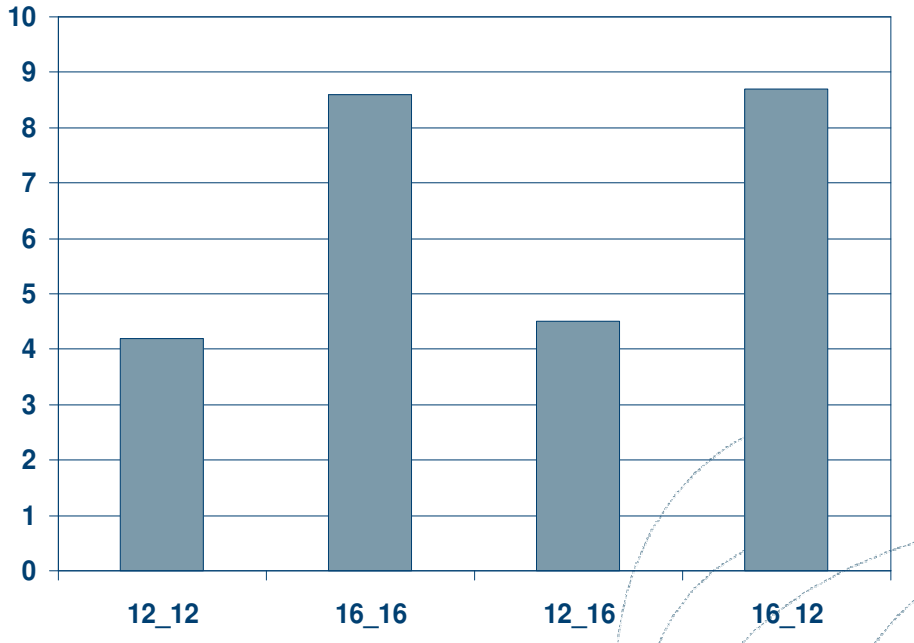
Spinal deformities at harvest in A. salmon underyearlings

Effect of temperature regime during smoltification



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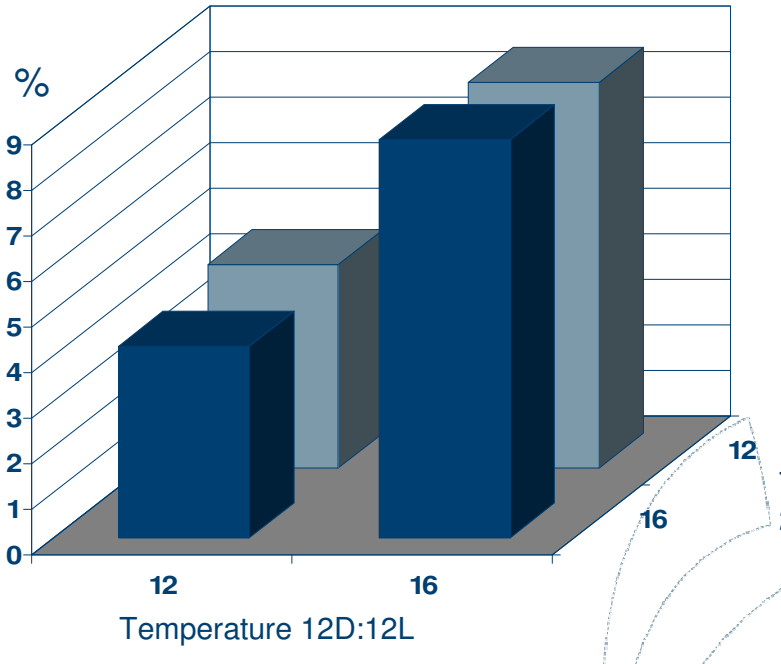

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Cardiosomatic index in A. salmon smolts

CSI: Heart weight relative to body weight

12D:12L	24L 12	24L 16
12	0,1165	0,1003
16	0,0982	0,1095

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Exp 3 Procedures during photomanipulation

1. Epidemiology data:

   Vaccination during 24L doubled the risk of spinal deformities at harvest compared to vaccination during 12D:12L

2. Observations from commercial production:

   Pressure towards a shorter 12D:12L period

   6 weeks > 5weeks> ??

Exp 3 Procedures during photomanipulation

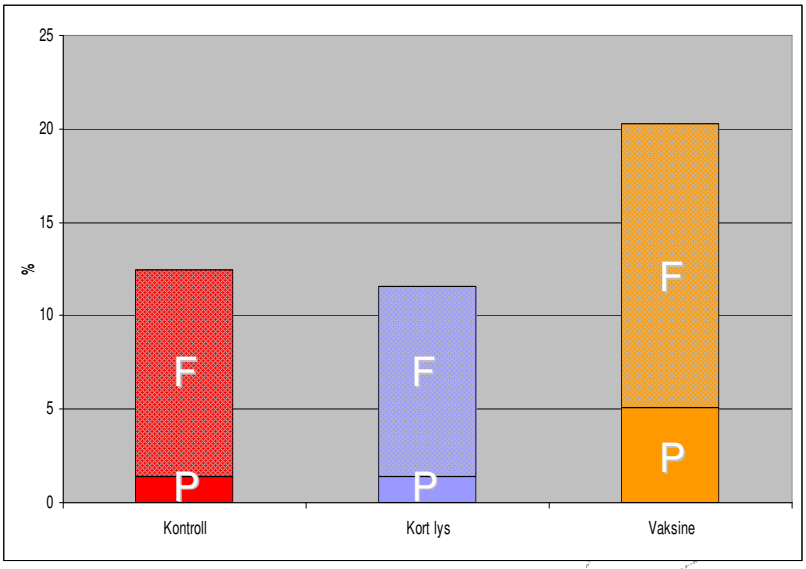
- Experiment started at start of photomanipulation, mean weight 21g

- **Control** 6 weeks 12D:12L, 6 weeks 24L
  Vaccination at end of short day treatment
- **Short winter** 4 weeks 12D:12L, 8 weeks 24L
  Vaccination at end of short day treatment
- **Timing of vaccination**
  6 weeks 12D:12L, 6 weeks 24L
  Vaccination first week of 24L

3 og 3 parallel groups, common sea cage
Harvest at ca 3,5 kg

Spinal deformities at harvest

Effects of deviations from standard smoltification procedures (0+)



F: Fusjoner
P: Platyspondyli

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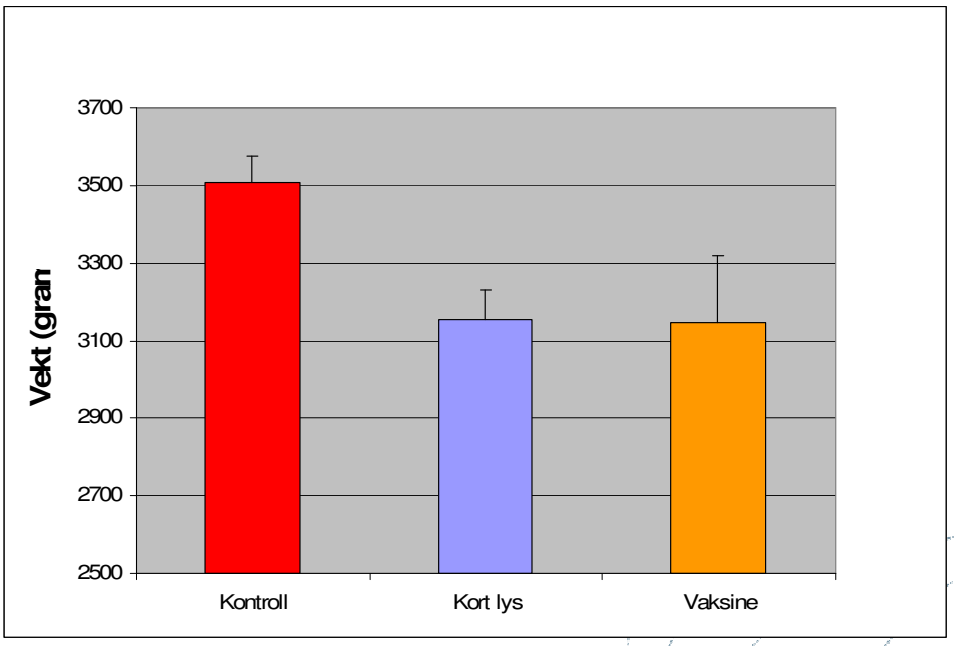
Weight at harvest

Effects of deviations from standard smoltification procedures (0+)



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Exp 4 Water quality during photomanipulation

- Based on observations that growth rate during smoltification is variable and unpredictable and generally not well monitored
  - Biomass may be poorly controlled
  - Water supply may be unpredictable
  - Oxygen supply control may be poor
- Max biomass in underyearling production during summer when natural temperatures are at the highest
- Max biomass in underyearling production at a time when yearlings start gaining weight and water supply may be short
- ”Just waiting to send the fish off”

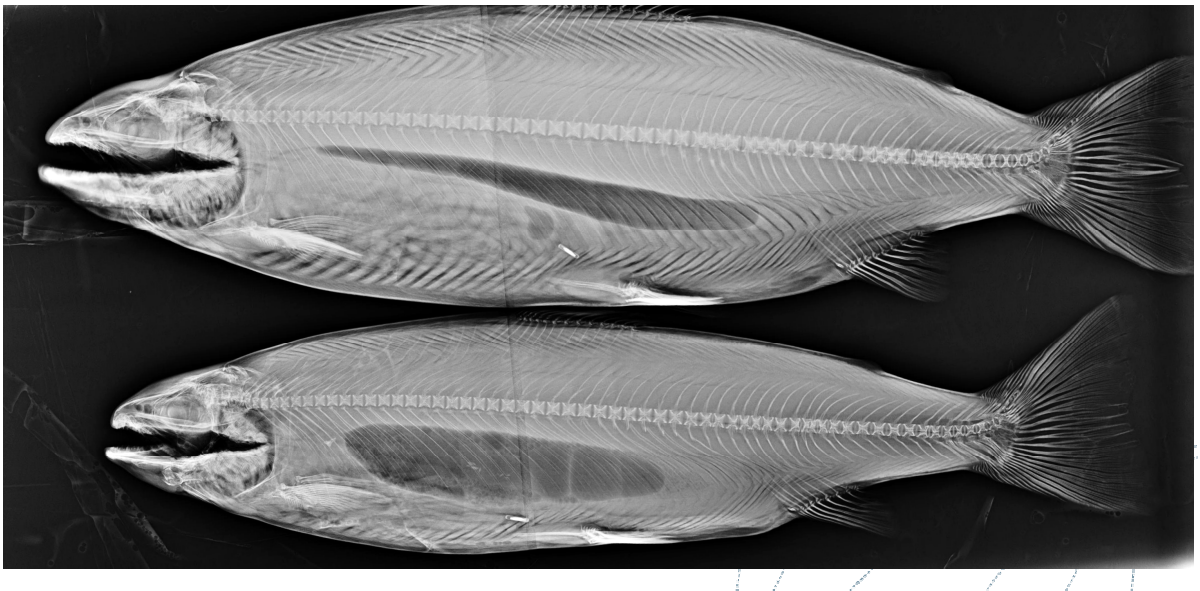
Water quality, experimental setup

- Control — Low biomass, no oxygen supply
- Normox — High biomass, oxygen added to 80-90% saturation in outlet water
- Hyperox — High biomass, oxygen added in excess, 110-130% in outlet water

- Water temperature controlled at 12°C
- Oxygen supply adjusted manually, based on daily O_2 readings

Water quality, results

- High number of fish with ”true” platyspondylia



Water quality, results

- Fish with platyspondylia
  - Highest in the high density, normox group
  - Double, compared to the control and hyperox

- There are still some things we don’t understand!
- More to be learned from this material

- The normox group suffered the highest variation in O_2 saturation during 12D:12L, from close to hypoxia during light hours with feeding, to hyperoxia during dark hours with no feeding