

# Case studies of Flesh Quality issues at Harvest in Atlantic Salmon in Scotland

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# Outline

- 3 Case studies of downgrading and rejects
- Pale muscle
- Difficulty in skinning fillets
- Linear melanisation of the peritoneum

# PALE AND MELANISED MUSCLE AT HARVEST

— Customer complaints about flesh discoloration





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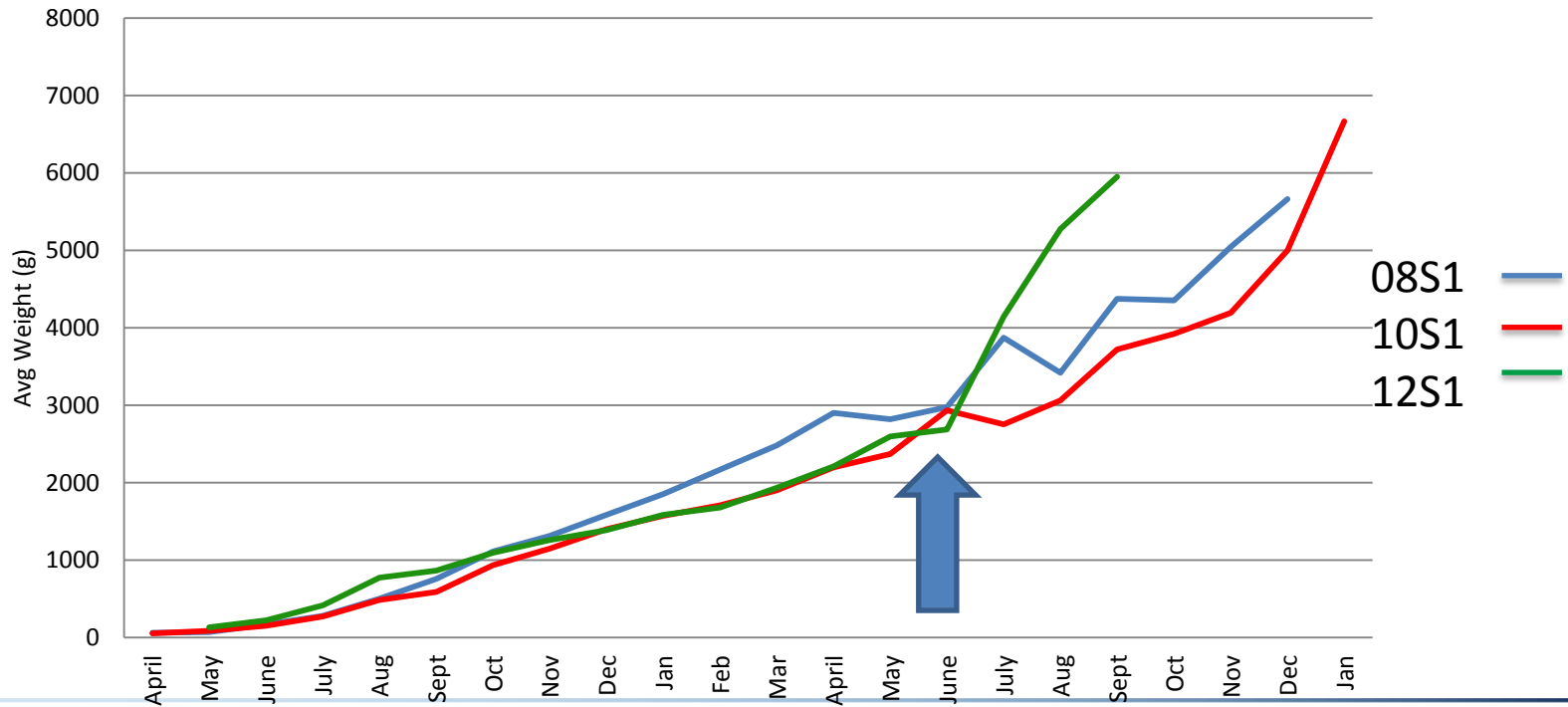
# Site History

- 525,495 Fish transferred to Site A April 2012
- All vaccinated with Alphaject 2:2 followed by Norvax Compact PD ( Feb 2012)
- All feed same high energy diet. (Av 33-36% Oil)
- 230,000 fish moved by well boat from Site A to Site B late Sept 2012 (860g)
- **Site A** current **7.3cm/s** & **Site B 16.7 cm/s**
- Not graded post transfer
- Health -AGD / Plankton issues ( A 17.3%) B (11.26%)
- No PD recognised

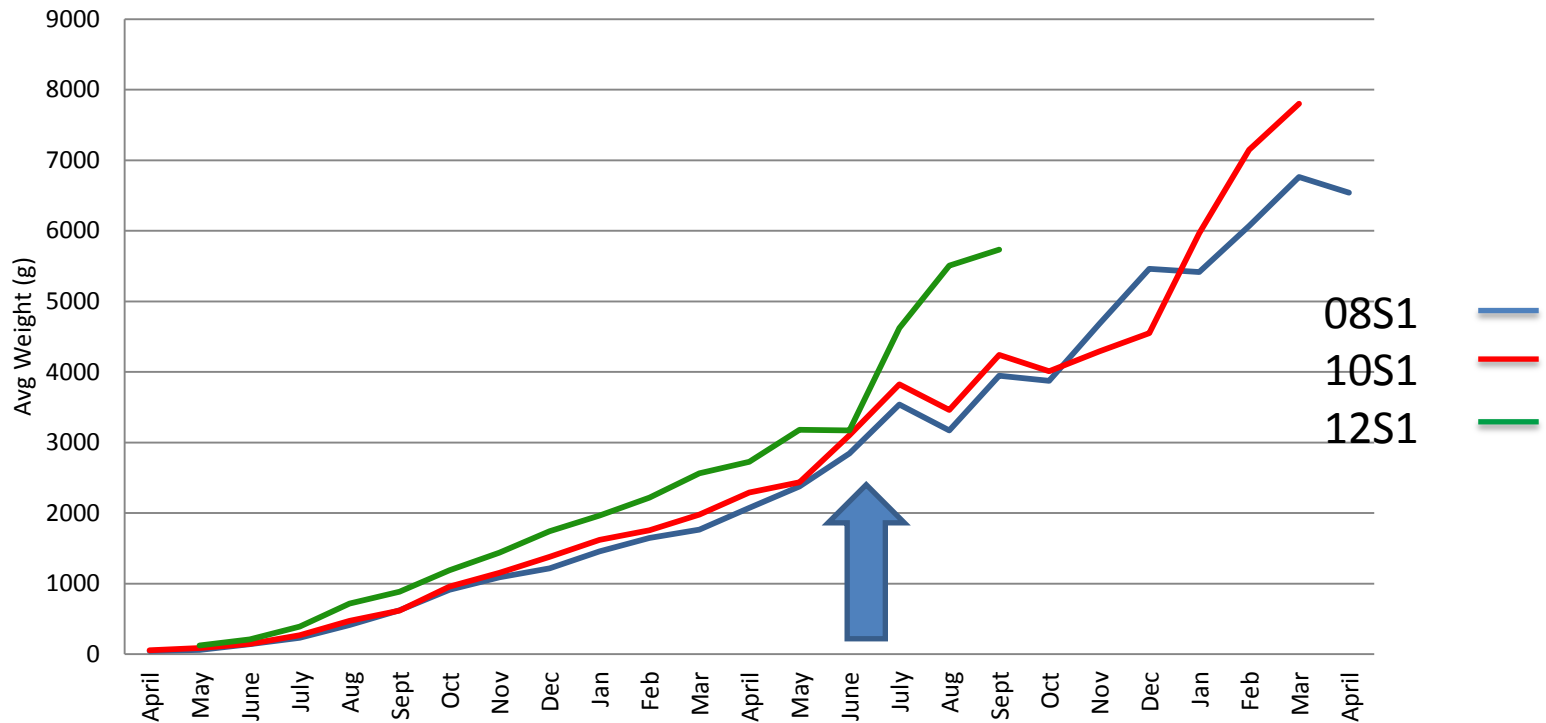
# Other Relevant history

- **Site B fish** positive for SAV 2 at harvest (Oct 2013)
- Fish from harvest pens 7 & 4 examined @ harvest
- Pen 7 -7/8 SAV antibody, Pen 4: Negative for SAV Ab, but 9/9 PCR SAV positive.
- Pens 1,2,3,6,& 8 sampled on site all SAV Antibody positive 21/10/13
- Pen 9 No SAV antibody 21/10/13
- Suggests recent SAV/PD challenge but no clinical disease
- **Site A fish** – All negative for SAV antibody 21/10/13, no PD clinical disease observed
- All feed high energy diet, Asta ↓ 36→18 then ↑36 Mid Sept & 45 in Oct 2013
- **Significant growth on both sites over summer >2kg in 2 months**

# Site A Growth Comparison



# Site B Growth comparisons



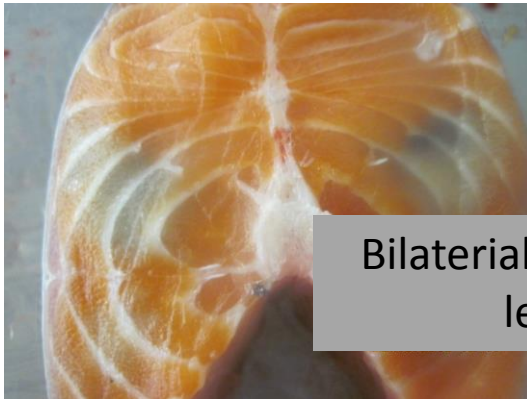


# Gross appearance of fish

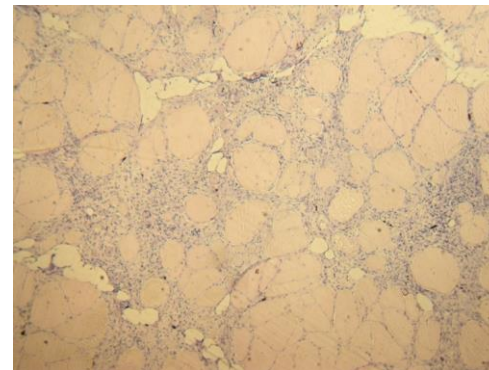
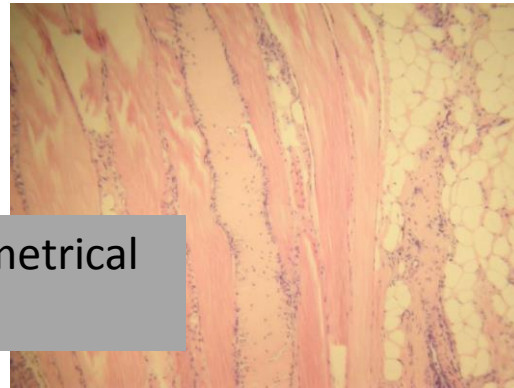
- Grossly all fish looked normal, good condition and plenty of pyloric caecal fat.
- 50% of random sample had muscle lesions  
22/10/13
- Butterfly bilateral pattern
- Extending from head to tail in some fish.
- Primarily white muscle



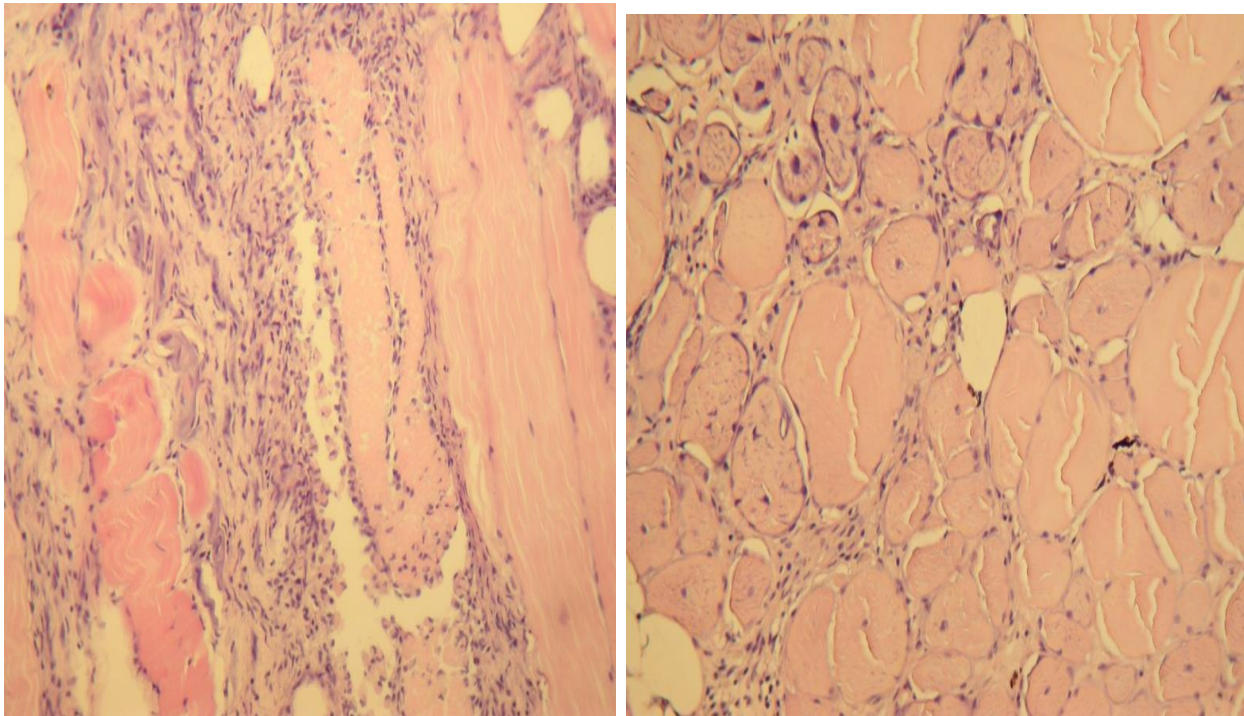
# Site B Gross & Histology



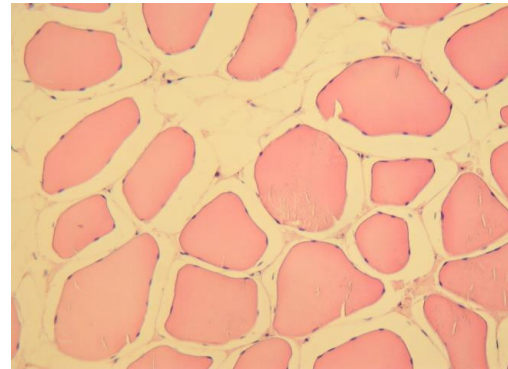
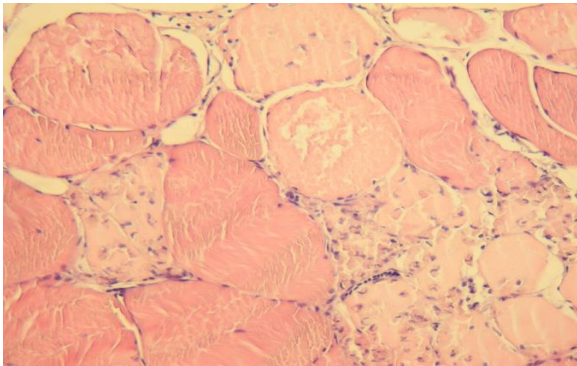
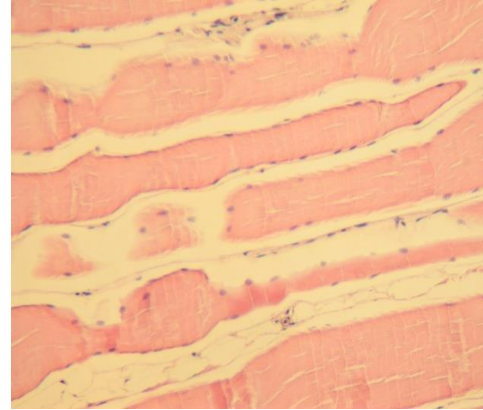
Bilateral symmetrical lesions



# Acute & Chronic lesions in same fish??

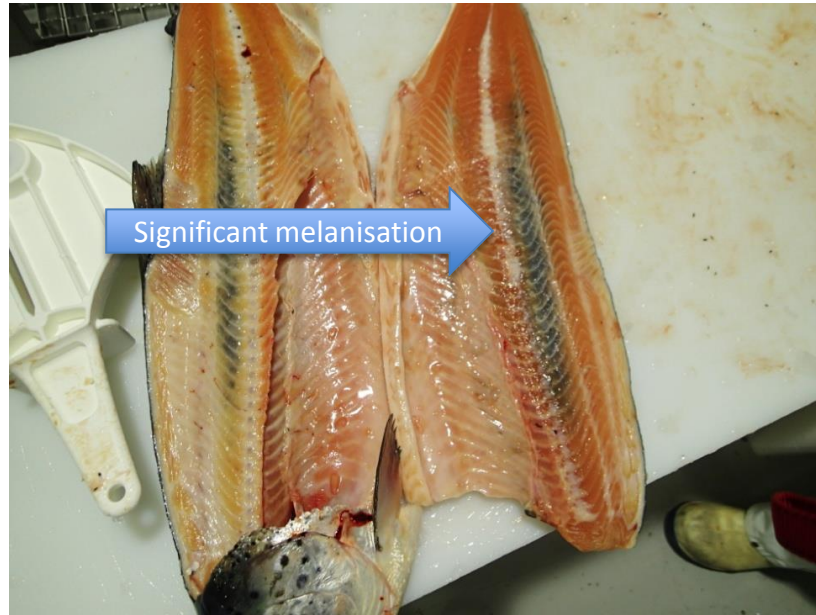


# Site A, Gross & Histology



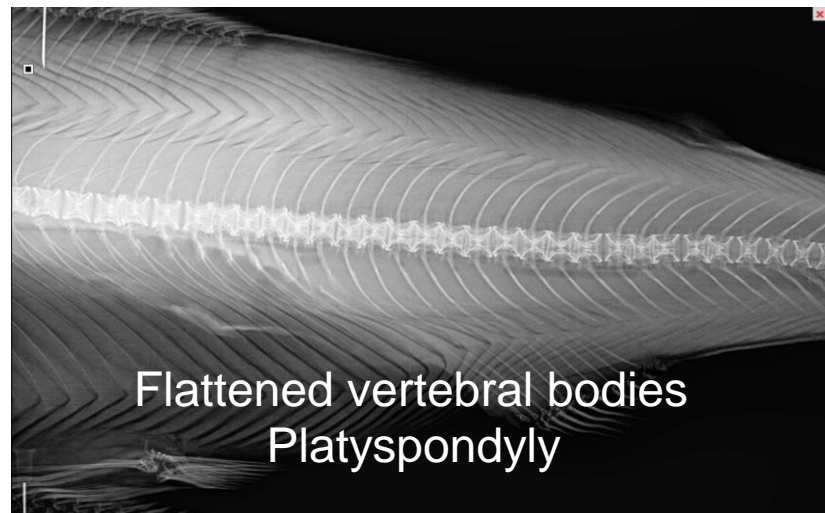


# Advanced Site A lesions



# X-Ray examination

- Platyspondyly of the caudal spine was found in 5/10 fish with flesh discoloration
- Chris Matthews FVG



# Site B Slaughter SAV

Fish No	Pen	SAV Antibody	SAV PCR HT	Ct value	CK
1	7	Neg	POS	31.55	1300
2	7	>1/40	POS	29.71	183700
3	7	1/30	POS	22.92	23600
4	7	1/40	POS	24.99	183800
5	7	>1/40	POS	25.07	27900
9	7	>1/40	POS	22.80	25100
10	7	>1/40	POS	22.67	13600
13	4	neg	POS	35.42	95400
15	4	neg	POS	26.04	23300

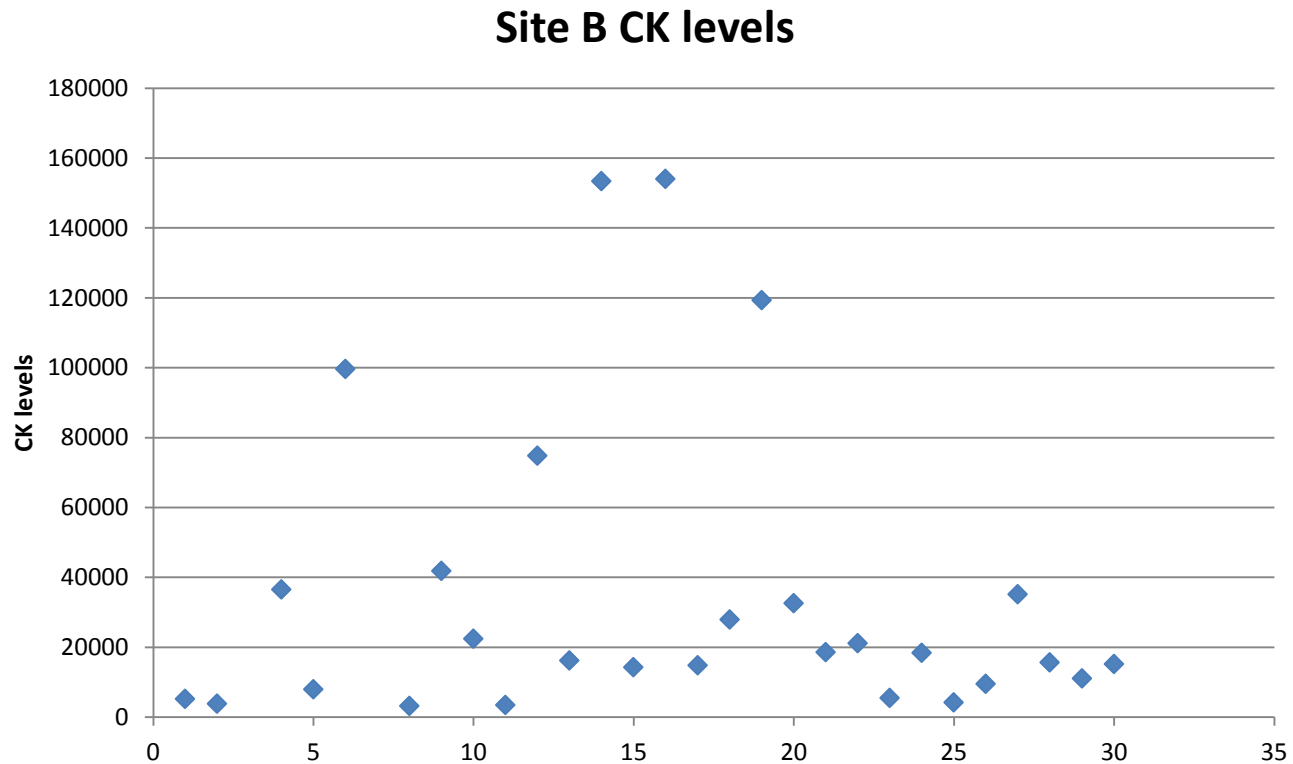
8/9 PRV Positive PCR ct >30

# CK levels Interpretation

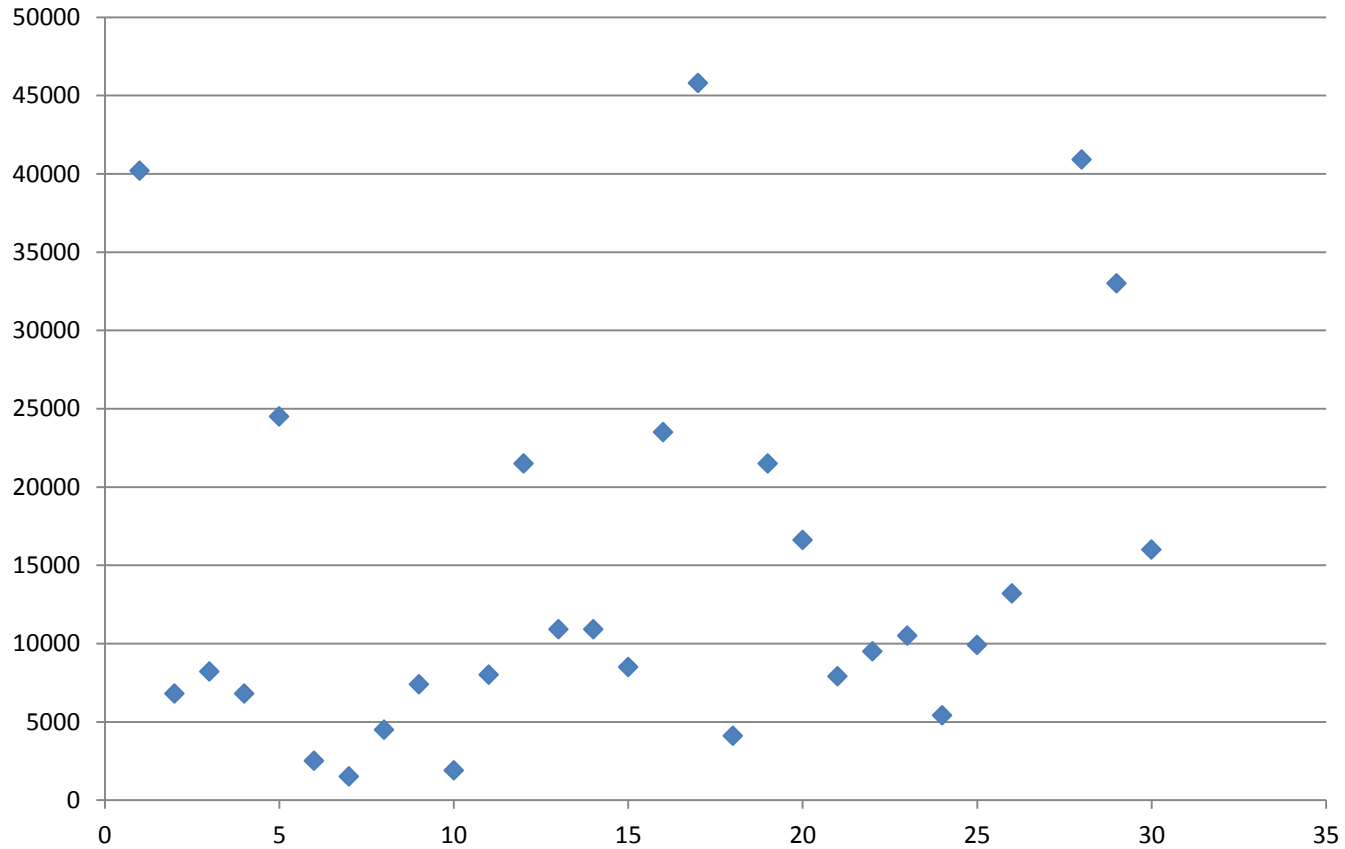
- CK levels rise if there is heart or muscle damage in a fish, but does not discriminate between heart and skeletal muscle lesions.
- For PD, ( based on MHS experience)
- Levels below 10,000 are considered normal,
- 20 to 30K is indicative of mild muscle damage,
- 30-80K is concerning
- > 80,000 revealing significant muscle damage.
- In cases of HSMI the CK level tends to be between 30 and 80K.



# Site B CK Levels



# Site A CK levels



# Summary of Findings

## Site A

- Similar gross appearance
- Similar prevalence 11.8%
- SAV negative,
- CK levels normal
- Mild myopathy & progressive melanisation
- Excess fatty tissue?
- Inadequate dietary pigment.
- Low Asta in pale tissue 4.7 vs 11.06 mg/kg in normal
- Negligible Vit C <0.05mg/100g

## Site B

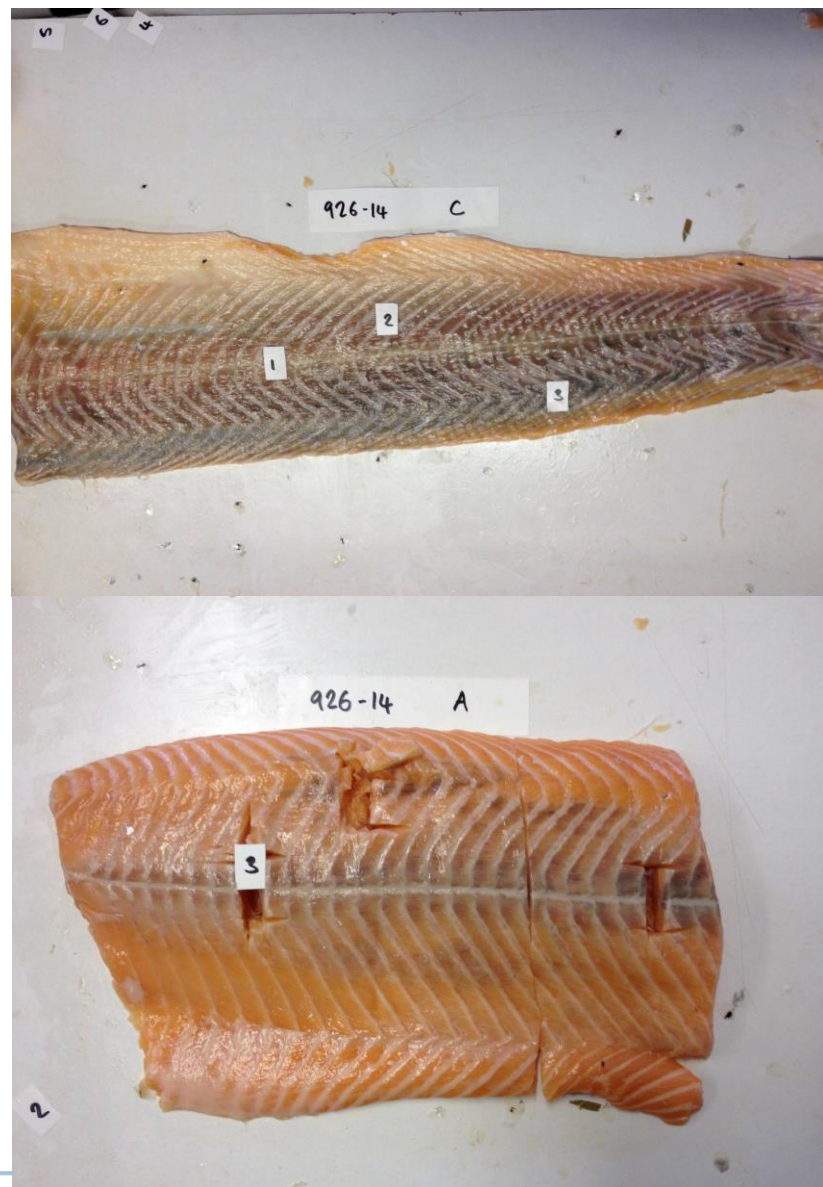
- Similar gross appearance
- Similar prevalence 12.8%
- SAV 2 Positive
- Some elevated CK levels (PD)
- Significant acute and chronic white muscle myopathy
- Focal melanin deposits
- PRV positive High ct levels
- No gut pathology.
- Pancreatic deficiency?

# Possible causes

- Two possible pathogenesis (lesion development)
- **Site A**, rapid growth, inadequate pigment and failure to absorb enough pigment during rapid growth especially in largest muscle fibres.
- Excess fat, increased oxidation, increased associated pigmentation/ melanisation
- **Site B**, rapid growth with late onset concurrent SAV infection triggers PD on top of Site A picture.
- Cataracts in Ireland last year, histidine levels normal- speculate rapid summer growth in S1's ( much higher sea temperatures & steeper Spring/Summer rise than normal)

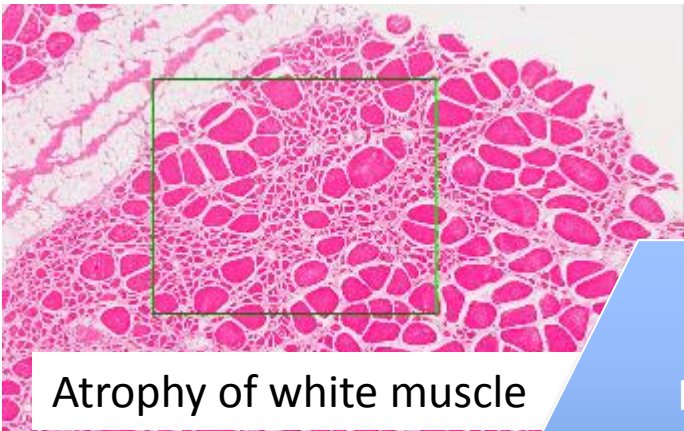
# Problems with automatic skinning of Atlantic salmon fillets

- Processing plant were finding it very difficult to remove skins from fillets
- Norwegian salmon from a SAV 3 endemic zone
- Site had history of PD in 2014
- Gross appearance

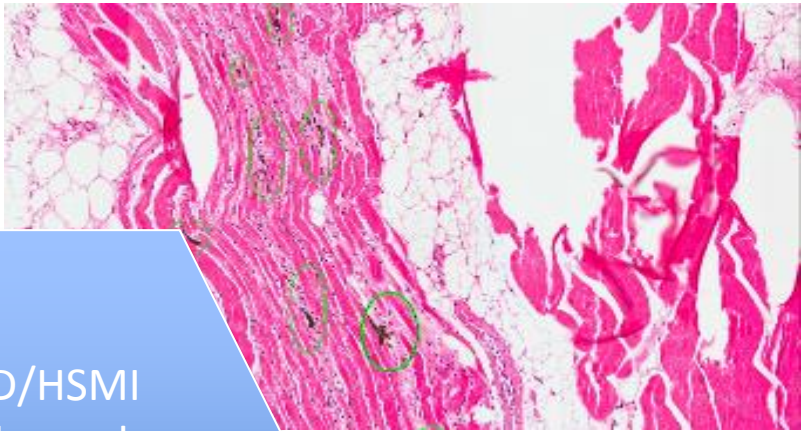




# Histology of affected tissue

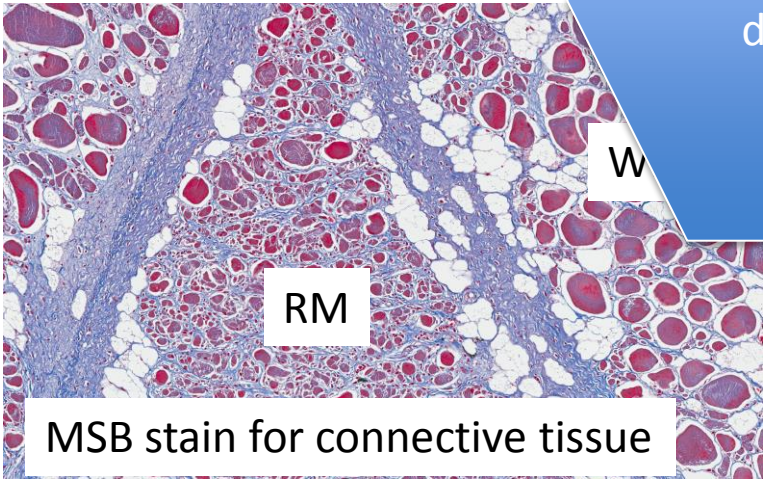


Atrophy of white muscle

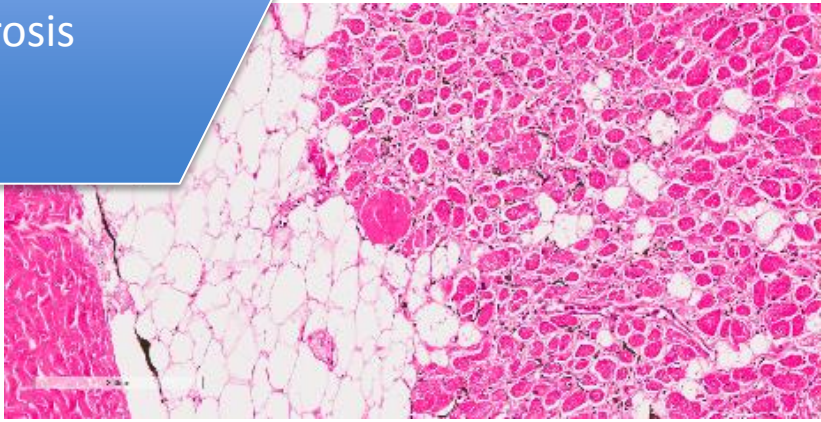


deposits in red muscle

Post PD/HSMI skeletal muscle damage and fibrosis



MSB stain for connective tissue



# Linear Melaninisation

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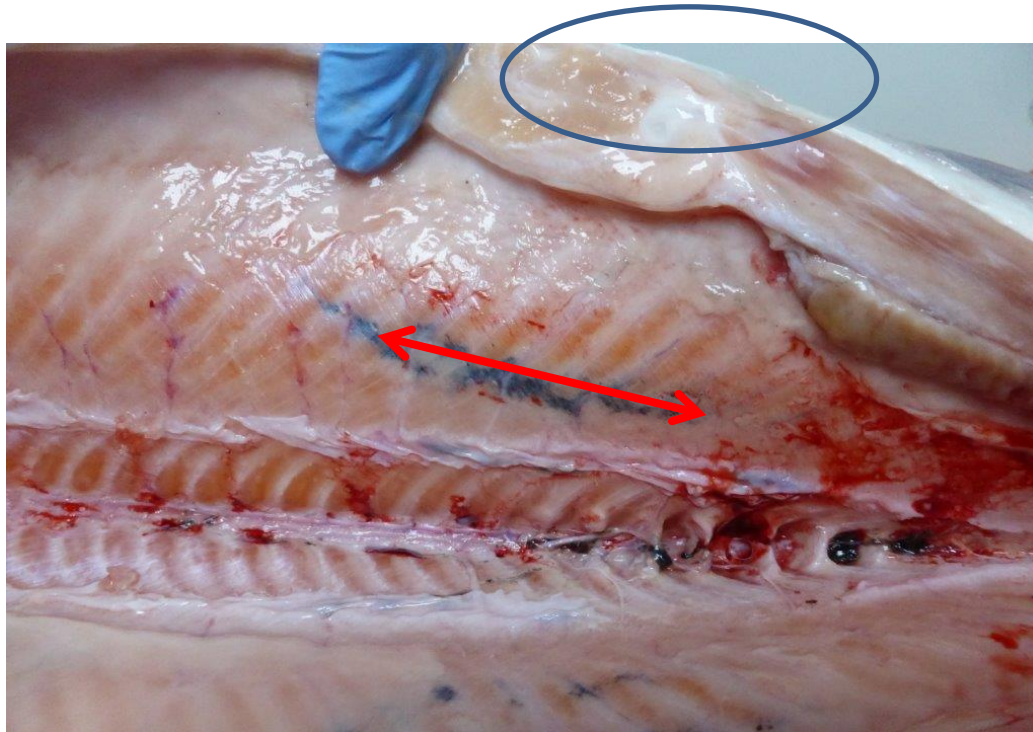
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# Background

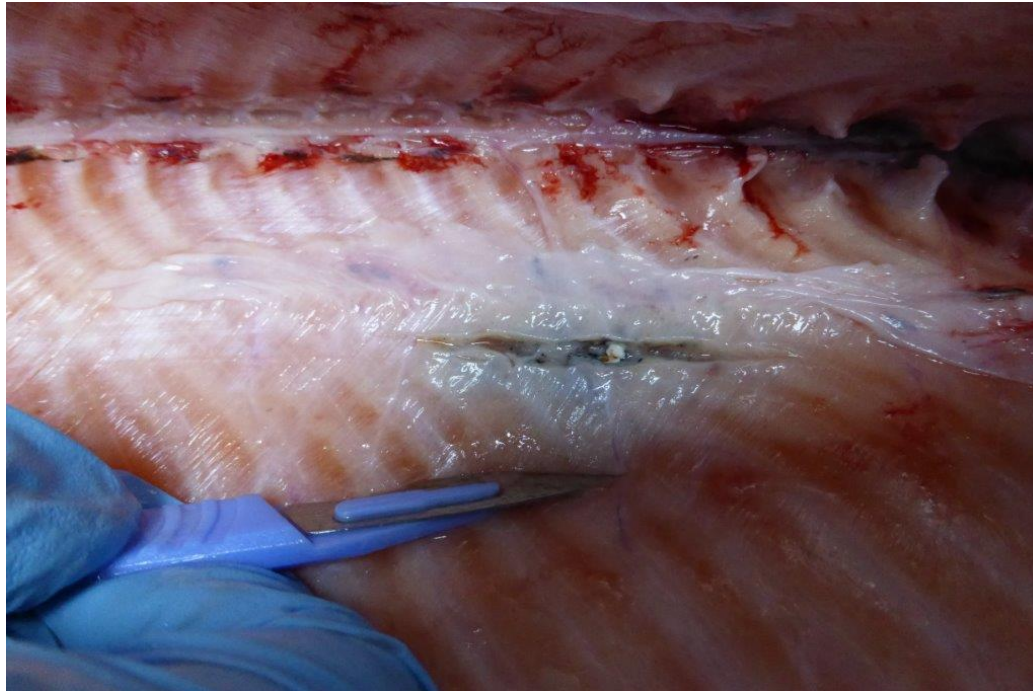
- Quality rejects due to melaninisation of peritoneum
- 5-6% in some stocks
- Initially thought to occur only on mainland sea sites
- Third party fish and off shore fish also now affected
- Gross examination of affected stock
- Revealed very consistent pattern of linear often bilateral melanised tracks with and without associated vaccine
- Preliminary diagnosis – physical damage at vaccination and or grading



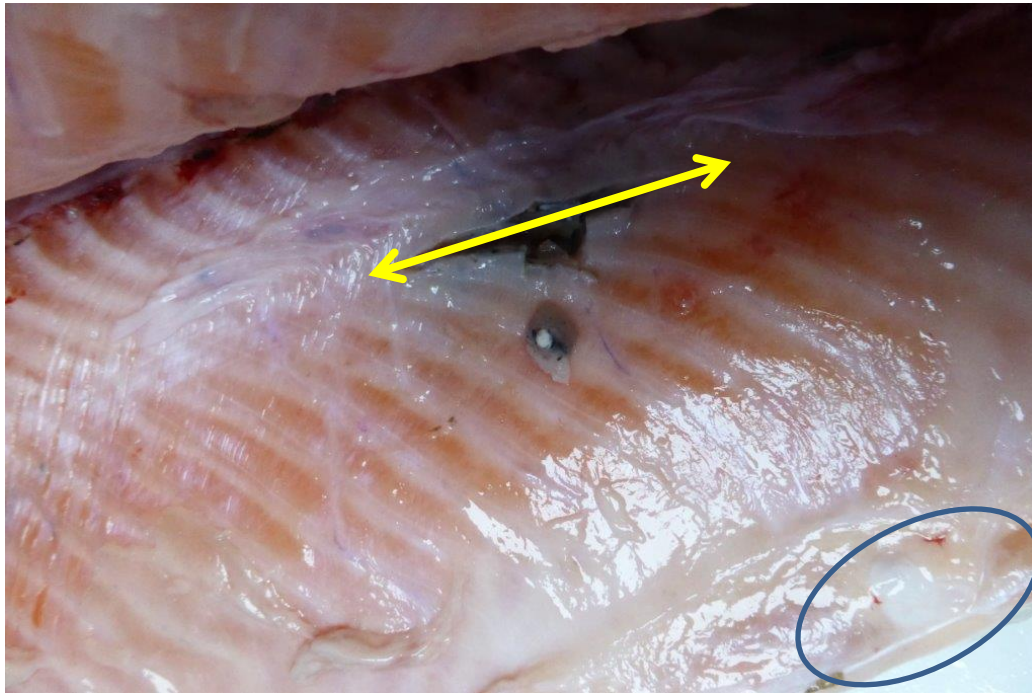
# Typical Gross lesions



# Linear lesion with vaccine nodule



# Vaccine removed

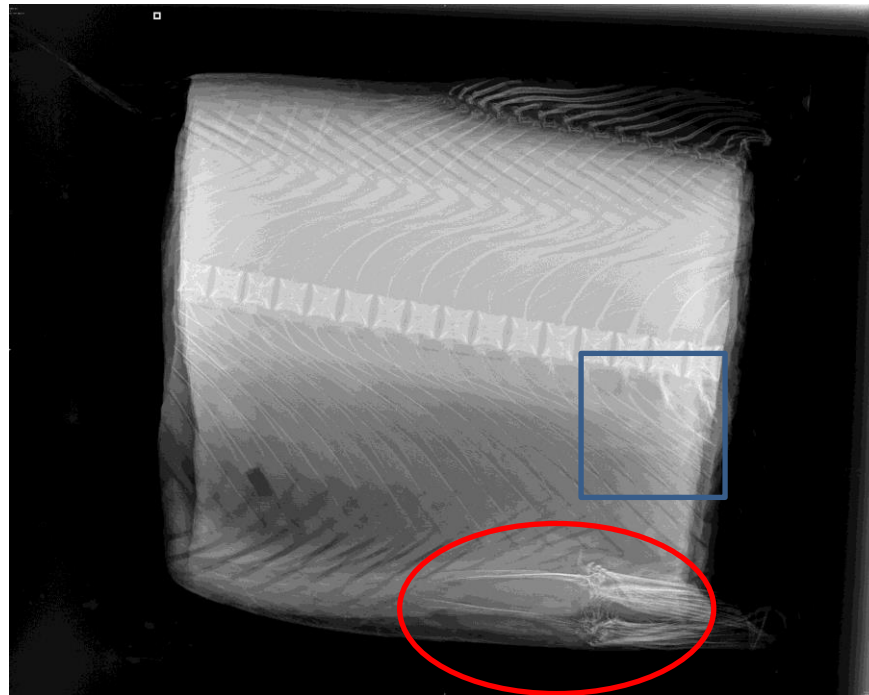


# Poor vaccination technique

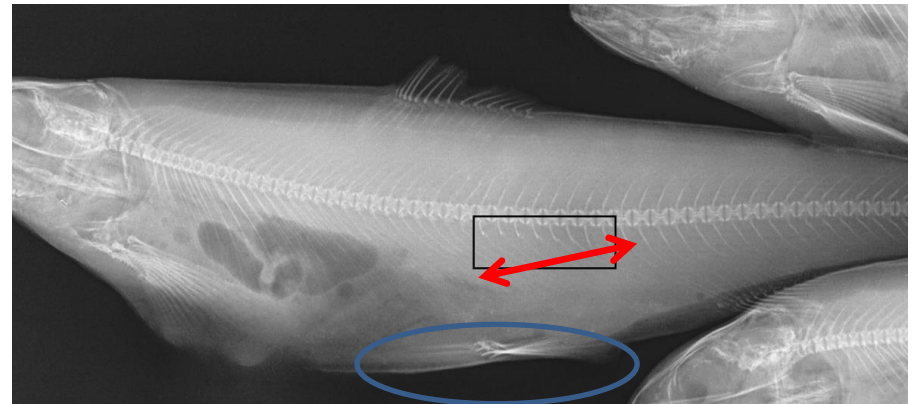




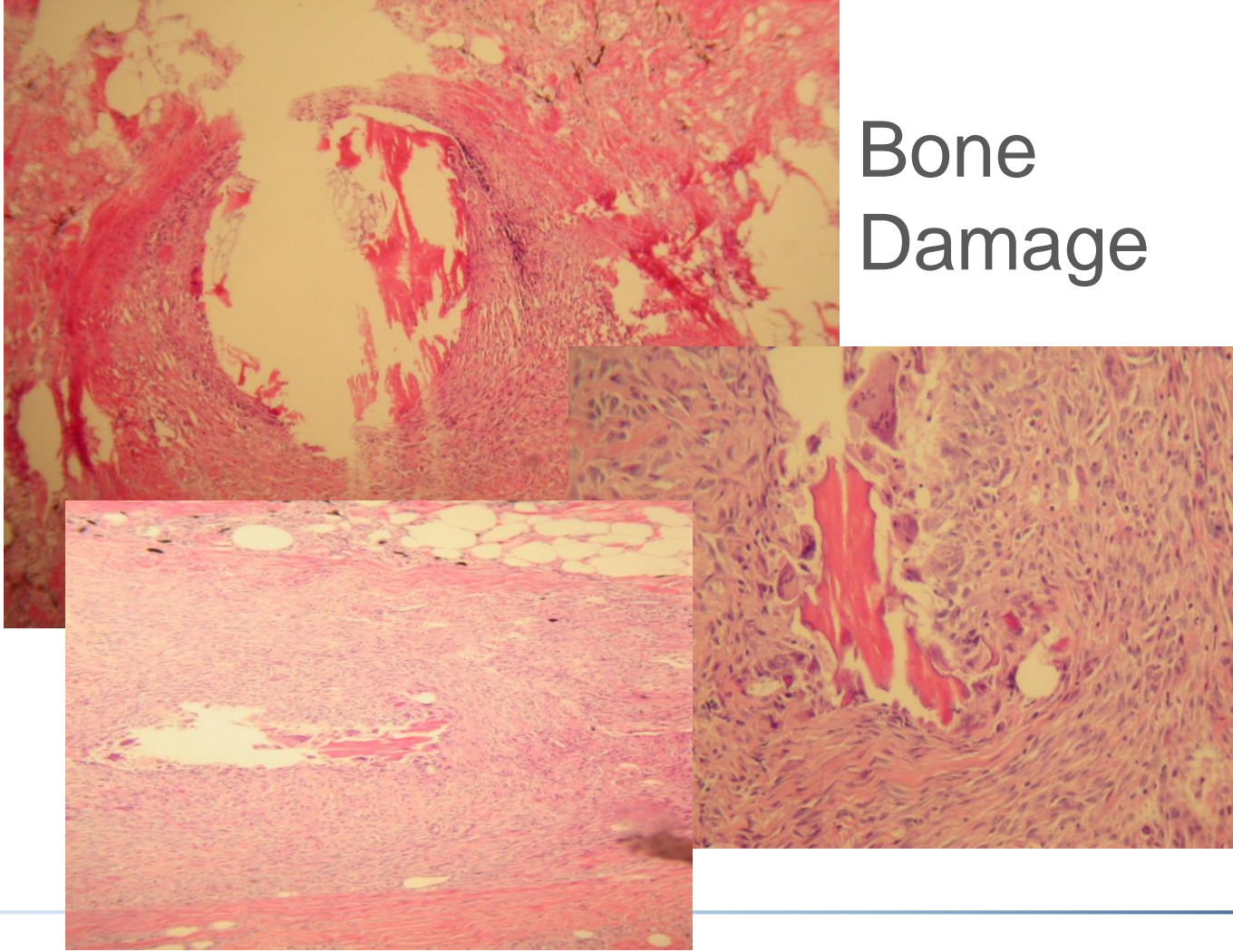
# X-Ray through previous fish



# X-Rays of cohort smolts

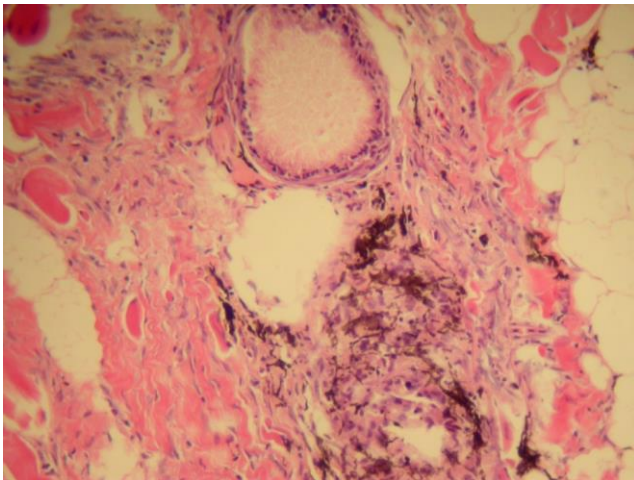


# Bone Damage

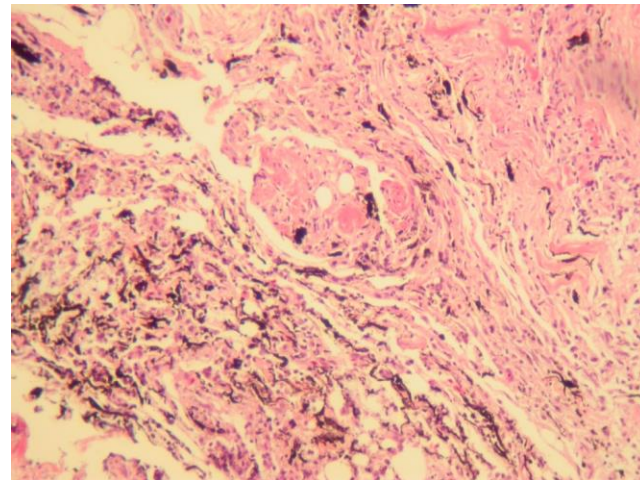


# Melanisation

**Vaccine granuloma + melanin**



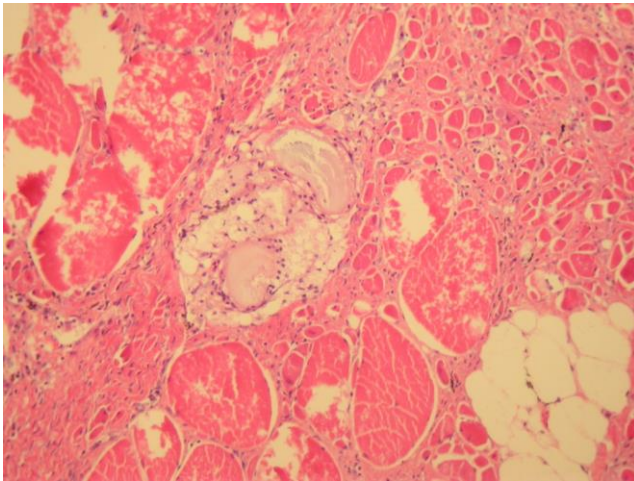
**Dendritic melanisation**



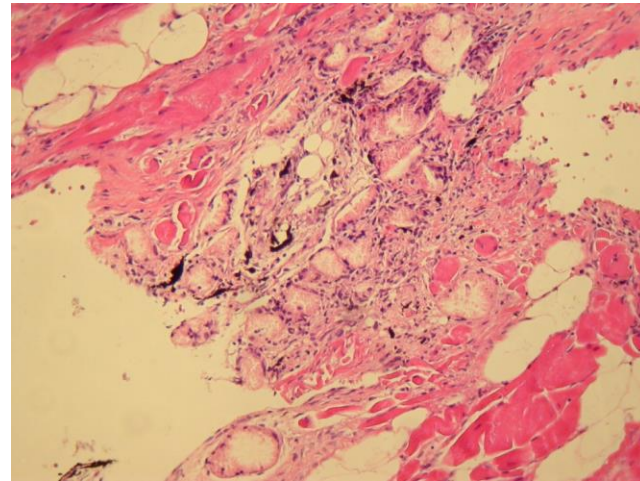


# Histological lesions

**Severe fibrosis + vaccine**

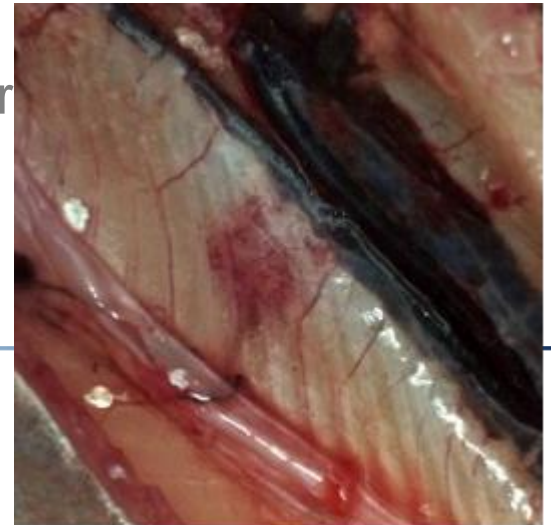


**Vaccine, melanin & inflammation**



# Conclusions to date

- Lesions probably caused by crush or physical damage close to vaccination
- Broken or damaged rib bones perforate peritoneum
- Vaccine embeds in damaged tissue, resulting in classic vaccine granulomata and melanisation
- Melanin could also be mobilised by the physical damage.
- Need to observe and adapt grading and or handling to avoid future issues
- Underwater pumps and seawater penetration should be investigated.



# Summary

- Carcase / fillet downgrading or rejection has many causes
- Detailed description and examination of lesions is required
- Primary insult/cause may have occurred many months prior to harvest
- Need to do retrospective investigation of handling, vaccination, diet, infectious disease etc.
- Test harvests very important
- Use of biological markers of muscle damage may be useful

# Acknowledgements

Any  
questions?

- Farms,
- MSD Animal Health,
- Chris Matthews, FVG
  
- Thank you!

