

## Fish Health Update

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## Overview

- GILPAT epidemiology
- Amoebic gill disease
- Puffy skin disease
- Salmonid alphavirus (PD virus)

## GILPAT project

Hamish Rodger  
Vet-Aqua International



Ireland's EU Structural Funds  
Programmes 2007 - 2013

Co-funded by the Irish Government  
and the European Union



EUROPEAN UNION  
STRUCTURAL FUNDS



## Causes of marine gill disorders

1. Harmful algal blooms
2. Harmful zooplankton swarms
3. Amoebic gill disease & other parasites  
(marine costia, *Trichodina*, microsporidian)
4. Bacterial gill disease (*Tenacibaculum* sp., *Candidatus*  
*Piscichlamydia salmonis*, epitheliocystis bacteria – *Candidatus* *Branchiomonas*  
*cysticola*)
5. Viruses (paramyxovirus , pox virus?)
6. Toxins, peroxide, other irritants, etc.
7. Unsubs & mix of above

## GILPAT project

- Epidemiology
  - Literature review
  - To clarify pathology, investigate evidence for infectious aetiology, whether or not there were non-infectious components of disease and
  - Provide recommendations for mitigation and areas for further research



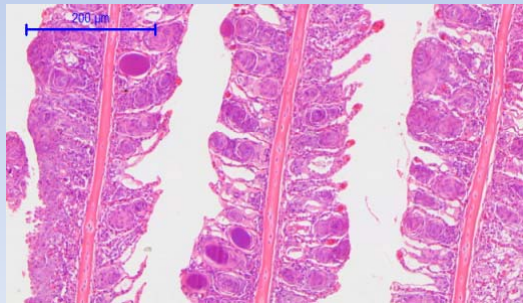
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## Literature review

- Two major reviews published 2011
  - Infectious gill disease in *Journal of Fish Diseases*
  - <C:\Users\Hamish\Documents\Papers\published\Infectious Gill Disease - JFD 2011.pdf>
  - Non-infectious gill disease in *Reviews in Fish Biology and Fisheries*
  - <C:\Users\Hamish\Documents\Papers\published\Non-infectious gill disorder paper RFBF.pdf>

## Literature reviews

- Lists of recommendations for further research
- Sources for support?



## Epidemiology

- Four site study published in Veterinary Record (2011)
- <C:\Users\Hamish\Documents\Papers published\4-site gill study paper 2011.pdf>
- Research editorial
- <Vet Record editorial 2011.pdf>



## Epidemiology

- 4 site sequential study findings
  - Primary insult to gills in some cases due to small harmful zooplankton
  - Coincided with tenacibaculosis & eventual parasitism
  - Associated with summer months
  - Spread from pen to pen in 2/4 sites
  - Strong genetic susceptibility
  - Significant economic loss for each site (also poor growth as result)

## Epidemiology

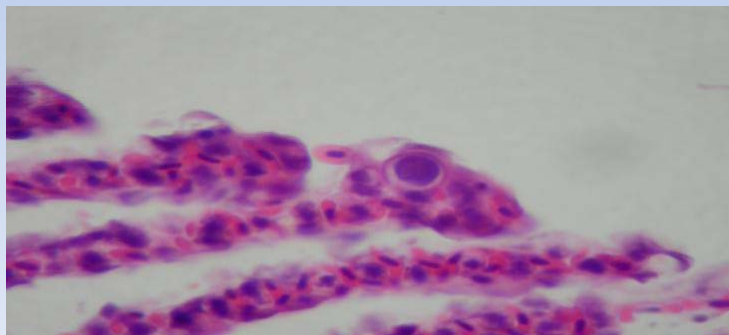
- National survey (2008 data)
  - 17 populations (13 salmon sites, 5.3 million)
  - 10/13 salmon sites had gill disorders, 1/3 trout sites
  - Average mortality 13%

## National survey of variables

- Location
- Smolt type
- Strain
- Vaccine
- Size at input
- Length of fallow
- Stock movement
- Input number
- Epitheliocystis
- PD
- Net washing method
- Distance to nearest farm
- Stocking density
- Feed type

## Highlights

- Epitheliocystis positive sites higher mortalities [28.3% ( $\pm 18.9$ ) cp. negative (7.0% ( $\pm 8.8$ ))]  $P=0.026$



## Highlights

- No *significant* difference in gill disorder losses comparing washer (21.7  $\pm$  18.2) to changing (15.3  $\pm$  19.0)



Alternate or improved net cleaning/changing system needed?

- [Gills\MIC-Technical.pdf](#)

## Highlights

- Strain of salmon

	Gill disorder mortality (%)	SD
Strain X	7.7	10.9
Strain Y	16.2	14.3
Strain Z	47.2	16.1

## Epidemiology

### 2010

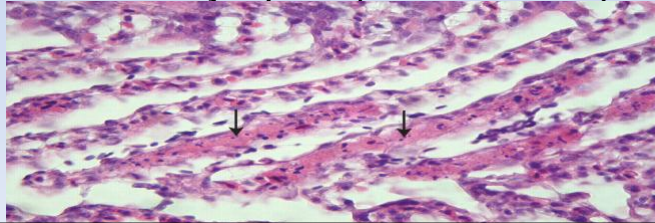
- 4/19 sites had some degree of gill disease
- $\frac{3}{4}$  low level mortalities
- $\frac{1}{4}$  high mortalities (zooplankton [*Muggiaea* plus *Solmaris*?] plus *Tenacibaculum* sp.)

### 2011

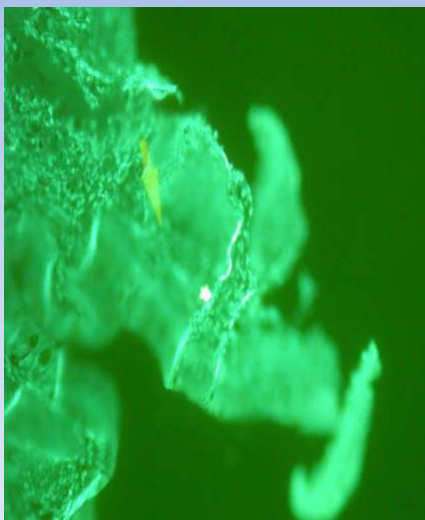
- 7 sites significant amoebic gill disease (AGD)
- Mortalities in some pens 80%
- *Karenia mikimotoi*
- *Muggiaea* sp. (500/m<sup>3</sup>)

## Pathology & Histopathology

- Gill pathogens in longitudinal farm studies (bacteria, chlamydia, amoeba, microsporidian)
- Development of a novel histopathological gill scoring protocol for assessment of gill health
- Gill pathology in farmed salmon associated with common jellyfish (*Aurelia aurita*)



## *Desmozoon/Paranucleospora* – microsporidean parasite



- EI voucher awarded to VAI (5000 euro) to commission work at AFBI
- 10% lice infected?
- Associated with PGI?

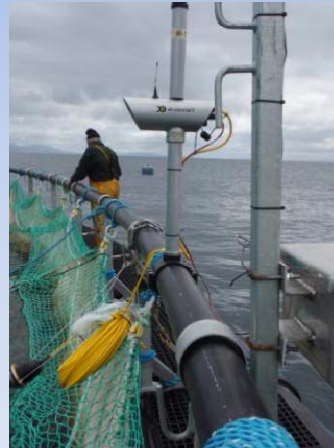
## Future

- Many areas for further research
- Zooplankton: what levels of *Muggiaea* are harmful?
- Do zooplankton harbour *Neoparamoeba* species?
- Do hydroids give rise to gill pathology?
- Is there any relationship between hydroids and amoeba (and *Tenacibaculum*)?
- Can we improve protective capacity of fish gills via diets? Vaccines?

## AMOEBIC GILL DISEASE (AGD)

## Outline

- Background & brief history
- The parasite
- Clinical signs & diagnosis
- Treatment/s and control
- Prevention & monitoring



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## Brief history of amoebic gill disease (AGD) in salmon

- Australia since 1980s
- WA, USA (1985 – 7)
- Ireland 1995 (8 sites), sporadic since until 2011 outbreak (9 sites)
- France & Spain (1995)
- Scotland (2006 – 7 [2 sites] & 2011)
- Norway 2006 (4 sites)
- Chile (2007 - )

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## AGD impact - Australia

- 10% stock loss/week untreated in Australia
- Reduced growth
- Freshwater baths prophylactic (13 x in 15 month cycle)
- 50 – 75 litre FW/smolt
- Adds 10 – 20% production cost
- 80c – AUD\$1/kg COP

Source: Dr. R. Taylor, CSIRO

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## AGD risk factors

- High salinity (> 32ppt)
- High water temperature
- Blooms or swarms?
- Biofouling?
- Smolt quality/size?
- Farming area/site?
- Other infected sites in area



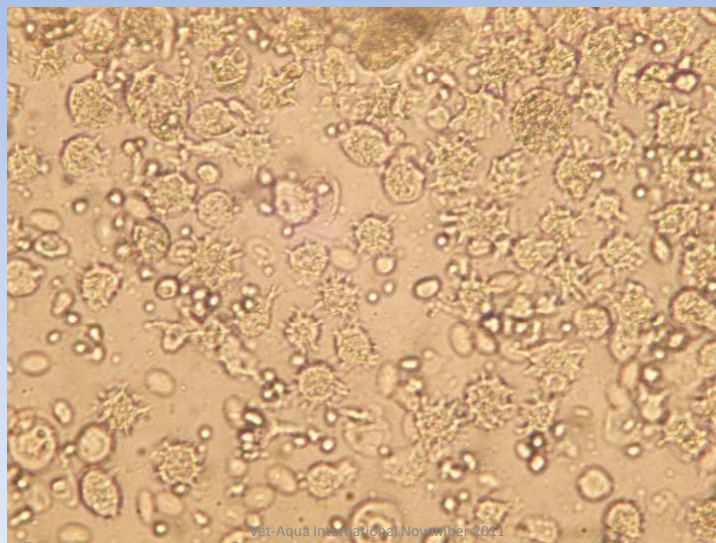
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## AGD 2011 – 1<sup>st</sup> indications

- France – July
- Ireland – August (and re-emerged October)
- Scotland – September
- Norway?
  
- Why?

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The parasite (*Neoparamoeba perurans*)  
- high burden on gill smear



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## *Neoparamoeba perurans*

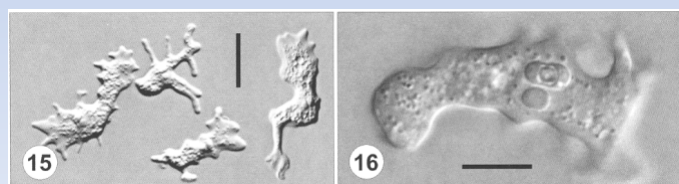
- *Paramoeba pemaquidensis*
- *Neoparamoeba pemaquidensis*
- Then confirmed new species
- *N. perurans*



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## *Neoparamoeba perurans*

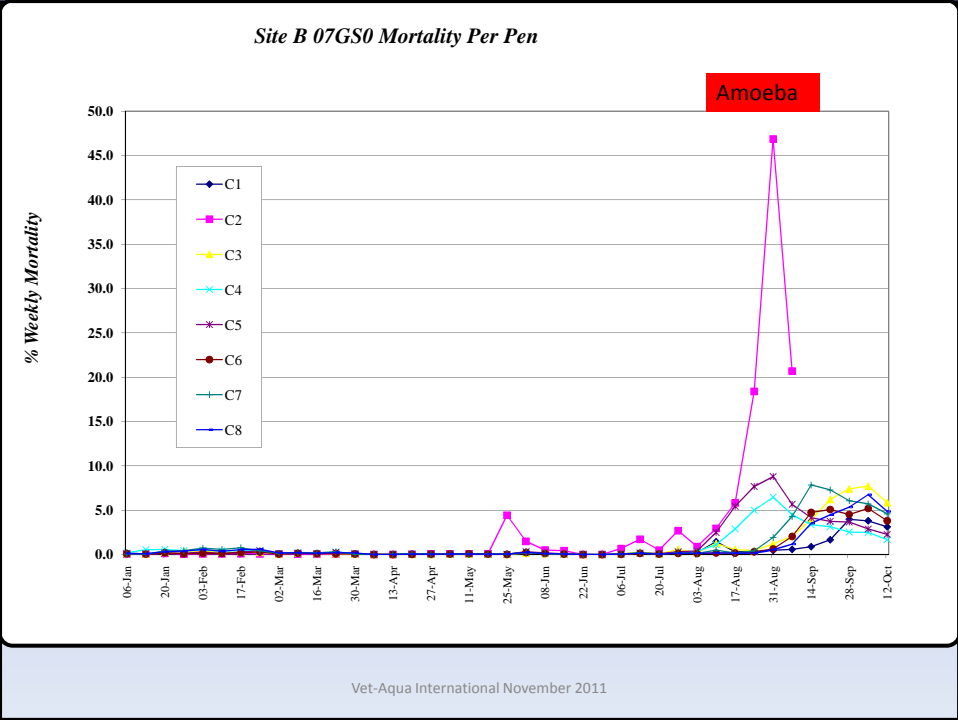
Free living & parasitic  
 Survives in sediment & net pens  
 Spread in seawater (>1km)  
 Survives in seawater at least 14 days

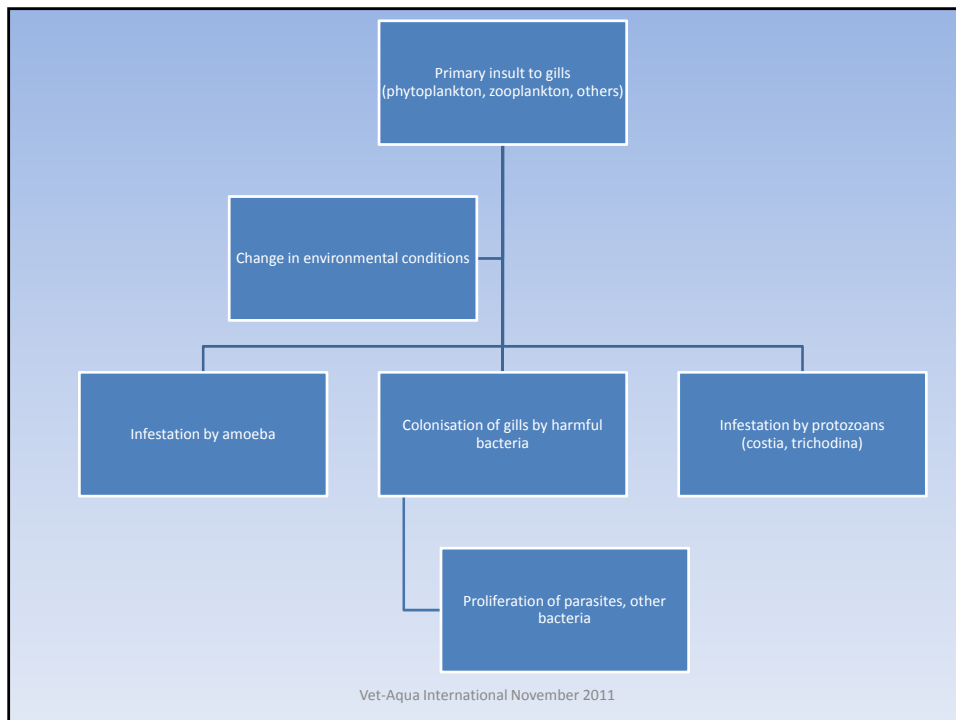
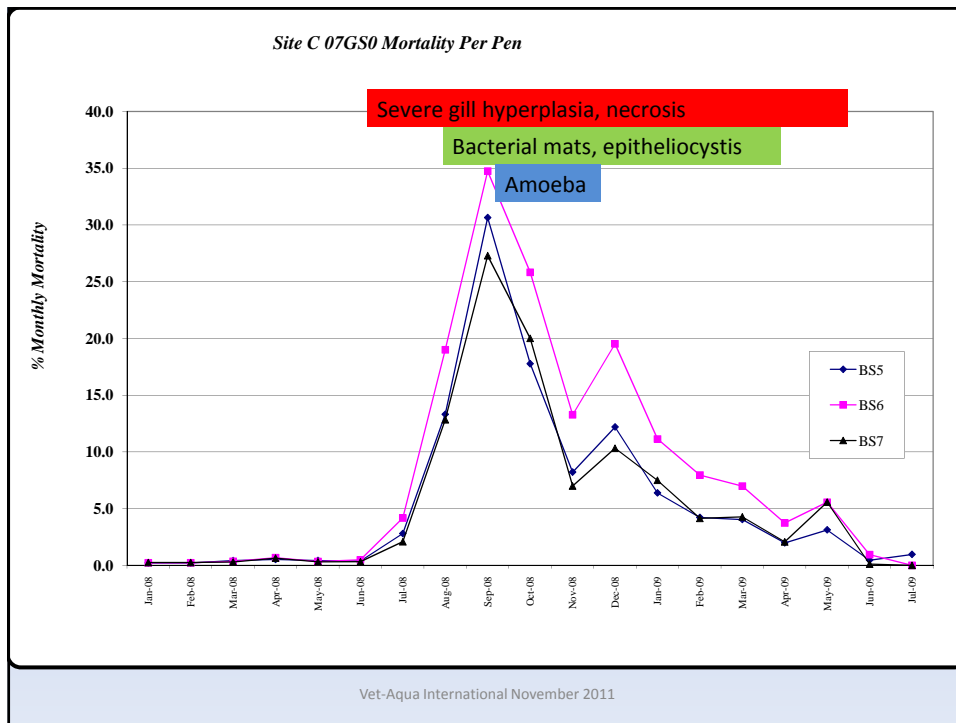


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**Gill scores (0 – 5)**  
 AGD gross pathology  
 -May underestimate AGD  
 -Smaller fish worst affected

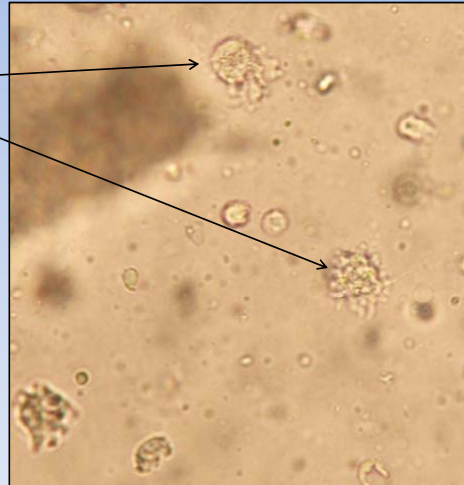
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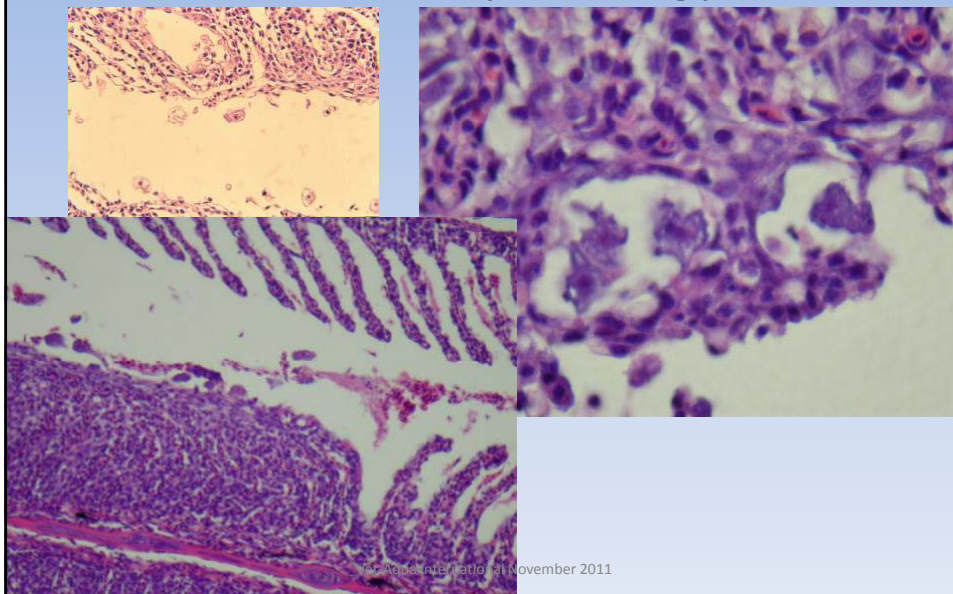
## Diagnosis

- Clinical signs
- Fresh gill smears (technique)
- Stained smears
- Histology
- Molecular (PCR)



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## AGD histopathology



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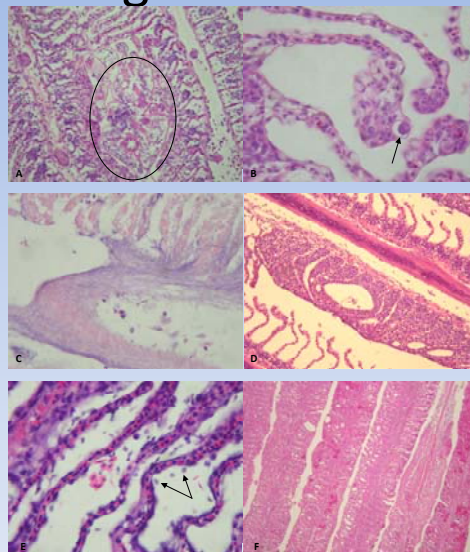
## Research - Ireland

- GILPAT project - duplex quantitative RT-PCR (Dr. E. Fringuelli, AFBI) for *N. Perurans*
- Longitudinal studies
- Also for *Tenacibaculum maritimum*, *Paramyxovirus*, *Paranucleospora* & *Piscichlamydia*



## Differential diagnosis

- Blooms or swarms
- Other parasites
- Bacteria
- Irritants (other WBIs)
- Multifactorial



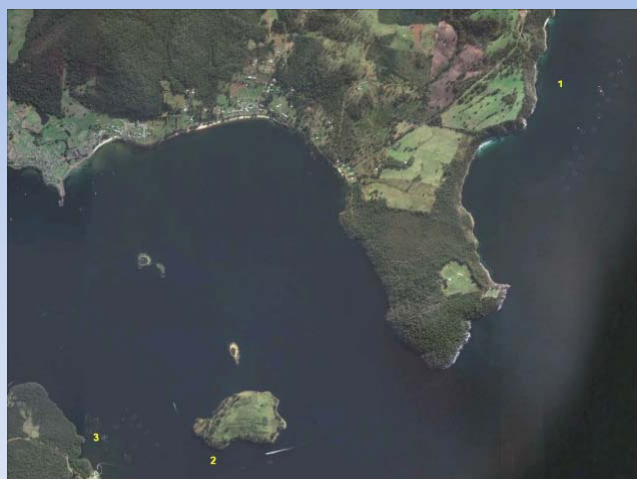
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## Treatment & control

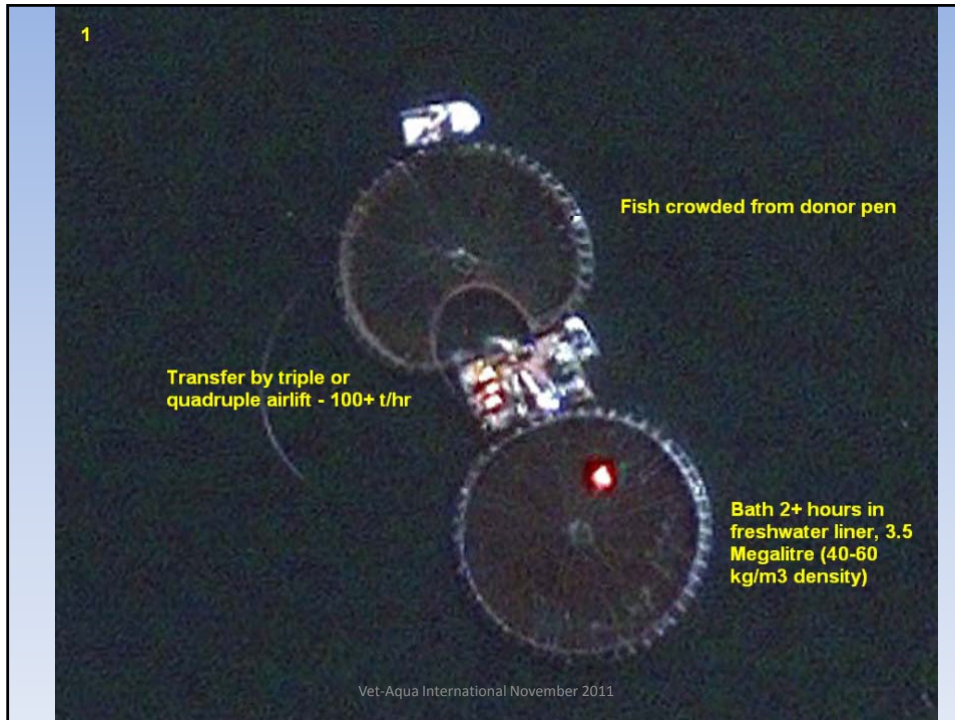
- Freshwater baths ( 2 – 3 hours), <3ppt
- Softer freshwater better
- Large number of others tried
  - Hydrogen peroxide
  - Formalin
  - Chloramine T
  - In-feeds

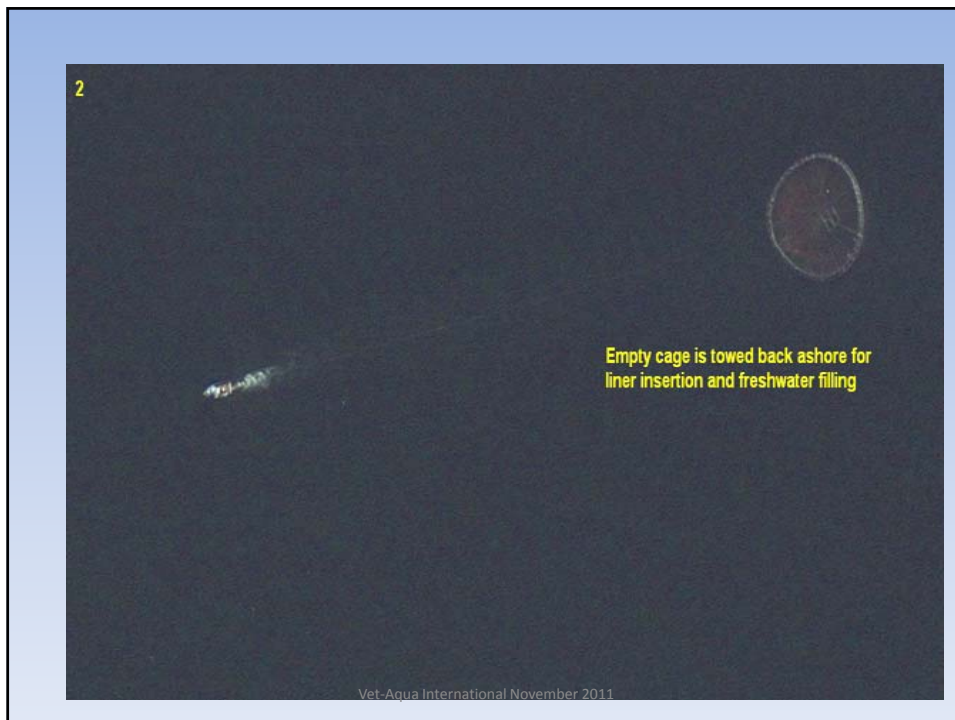
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## Freshwater bath treatments (Tasmania), courtesy of Dr. R. Taylor



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## Transfer of fish to treatment pen



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## Freshwater treatments in wellboat



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## Hydrogen peroxide in pens



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## Formalin baths



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## Prevention & monitoring

- Regular gill checks (weekly) for signs
- plus fresh microscopy during high risk period
- Histopath (& PCR)
- Staff training and awareness
- Net cleanliness & hygiene
- Mort removal

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## Future

- Genetics
- Improved freshwater bath treatments
- Vaccine?
- In-feed treatments?
  
- Will AGD recur?

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## Summary

- AGD major challenge for marine salmon farms
- Has caused very significant losses in Europe
- Early detection & preparedness crucial
- Freshwater bath treatments
  
- Be prepared

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## Acknowledgements

- GILPAT project (NDP, Sea Change) & partners Marine Institute (Dr. N. Ruane), AFBI (Dr. E. Fringuelli), UCC (Dr. E. Baxter & Dr. T. Doyle), Vet-Aqua Inter.
- Mr. Kevin Murphy (Westport)
- Dr. Richard Taylor (CSIRO)
- Ms. Susie Mitchell (Vet-Aqua Inter.)

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## Gill Health Workshop

- Vet-Aqua International
- March 2012
- At SAMS, Dunstaffnage, Scotland
- One-day workshop (AGD, jellyfish ID & sampling, research updates on gill pathogens)
- [vetaquainter@gmail.com](mailto:vetaquainter@gmail.com)

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## Trout disease

Puffy skin disease

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### **'Puffy Skin' Condition**

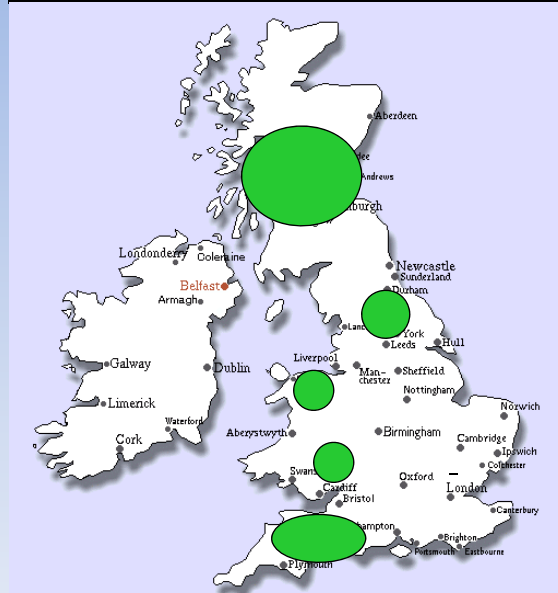


Photo & details: Robert Hughes, Skretting

### **'Puffy Skin' Condition - Incidence**

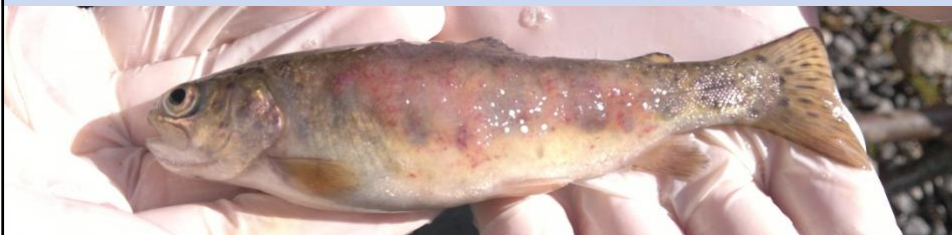
- Has been seen in most parts of the U.K. ( first seen 1997)
- Incidence has increased alarmingly in 2011
- 32 farms affected 2011
- Usually affects 1kg+ triploid rainbow trout. However...
- Increasing serious problem on some sport fisheries
- No causative organism found

## 'Puffy Skin' Condition 2011



### 'Puffy Skin' Condition - Symptoms

- Excess mucus on flanks of fish – no parasites
- Oedema of skin
- Blistering and loss of scales
- No muscle damage
- Loss of appetite and wasting
- Increase in deformity levels ?
- No internal symptoms
- No successful treatments



## PANCREAS DISEASE (PD)

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## Salmonid alphavirus (SAV) subtypes

- SAV 1, 4 & 6 confirmed previously in Ireland
- 2009/10 SAV subtyped from all regions
- SAV 2 spreading elsewhere

Site	B	C	D	E	F	G	H	I*
PD mortality	4.4	7.1	5	25	35	31	9.6	35
SAV subtype	1**	1	1	1	1	1	1	1

\* Site I in Scotland, \*\* minor difference within SAV subtype 1 (Graham & Fringuelli 2010)

## Sea lice?



*Lepeophtheirus salmonis*

*L. salmonis* is a risk factor with PD (Rodger & Mitchell 2007)

## Sea lice burden & PD mortality

- 5 years data (sea site PD mortality and *L. salmonis* total mean count [60 fish each site each month] in July and August)
- Moderate degree of correlation (significance  $P < 0.01$ )
- $n = 62, r = 0.32, P = 0.005$



*L. salmonis chalmis*

## Sea lice & PD

Farms with higher burden of lice have higher impact from PD and/or vv



Improved lice control, less impact from PD and *vice versa*

## Summary

- GILPAT epidemiology
- Amoebic gill disease
- Puffy skin disease
- Salmonid alphavirus (PD virus)