Fin Fish Farming
Significant Diseases & Trends

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Marine Institute
Foras na Mara

Overview

- Putting aquaculture into context
- Diseases of major economic importance
- Impact of vaccination on disease profiles
- Emerging trends in aquaculture

Fisheries / aquaculture

- Aquaculture's potential
- "Green" revolution
- Emerging trend towards high value carnivores ("piscivores")
- Industrial scale, multinationals
- Some sections due for reform

Fisheries / aquaculture

- Global fisheries production: 130 million tonnes 2001 (double that of 1970) †
- Capture fisheries grew 1.2% p.a.

- Currently 16% of animal protein consumed by the global population is derived from fish
- 1 billion + people depend on fish as their main source of animal protein

† FAOSTAT, 2001

Fisheries / aquaculture

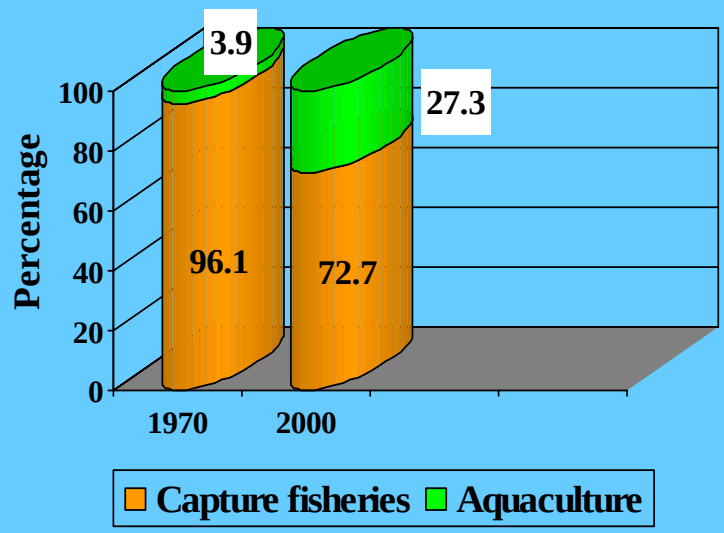
- c. “47% of main stocks…fully exploited…producing catches that have reached, or very close to their maximum sustainable limits” †
- Additional means…

†FAO, 2002. The State of world Fisheries and Aquaculture

Aquaculture

- 4,000 years?
- 1960's – Asia
- Aquaculture grew 9.1% p.a. (39.8 million tonnes 2002)
- Higher than other food production systems †

- USA – aquaculture exceeds combined production lamb, mutton and veal



† FAO, 2003

Aquaculture

- Majority of aquaculture growth – Chinese (>70% in 2002)
- More moderate growth†

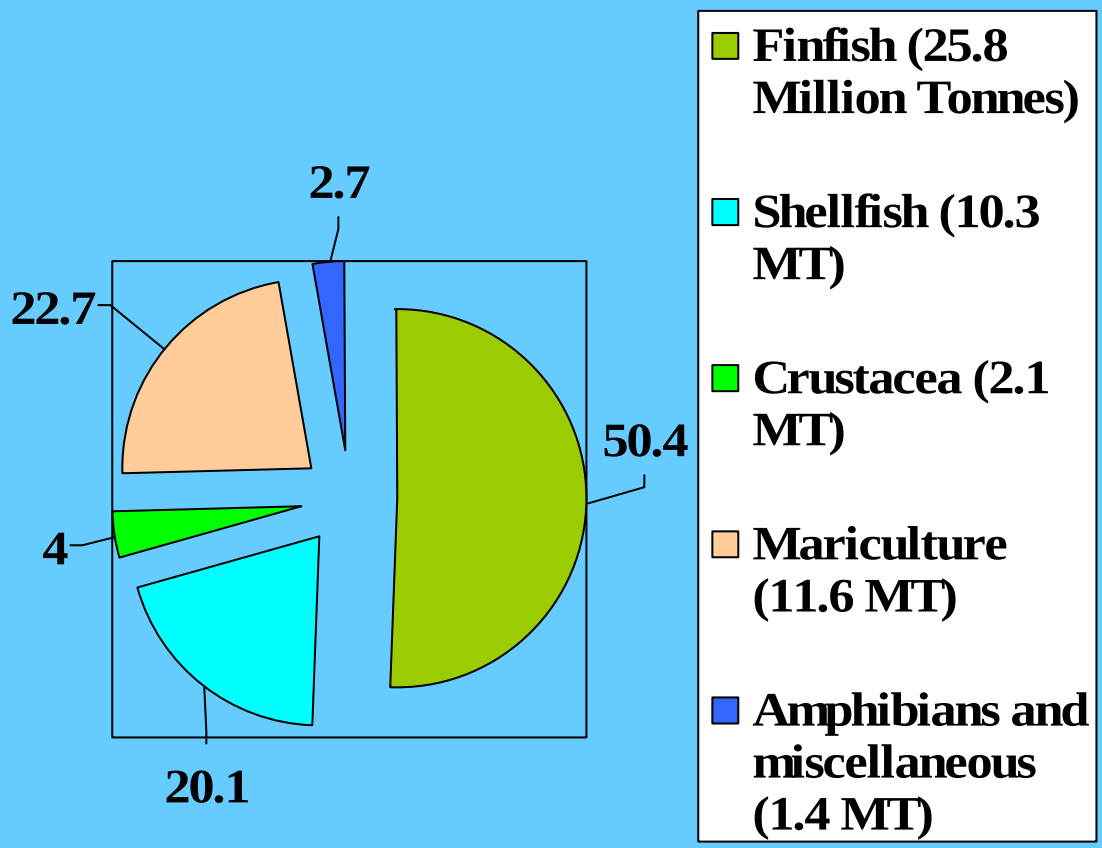
Period	1970-1980	1980-1990	1990-2000
Growth rate	6.8%	6.7%	5.4%

- Ye forecast: if 1996 per capita consumption remains static, population growth alone pushes demand over the available 99 million tonnes to 126 million tonnes[2].

†.FISHSTAT+, 2004, China not included; 2.Ye,Y. 1999, FAO Fisheries circular N. 946

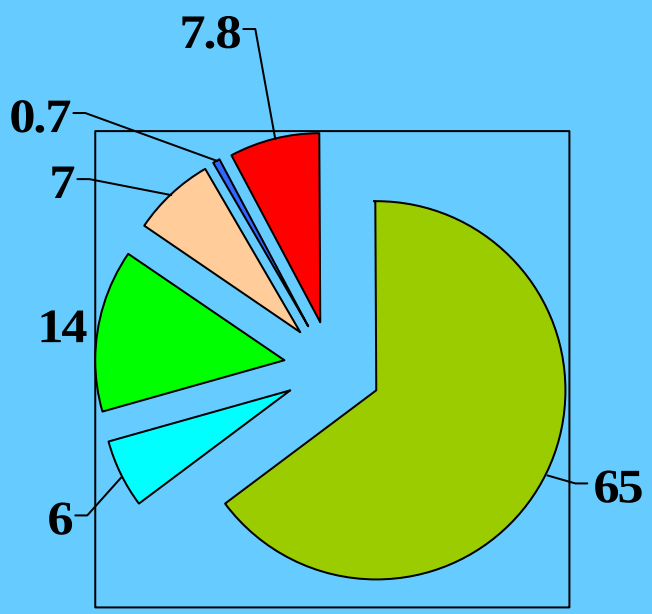
Status of Aquaculture

Percentage share of global aquaculture



Status of Aquaculture - finfish†

Percent share of finfish industries

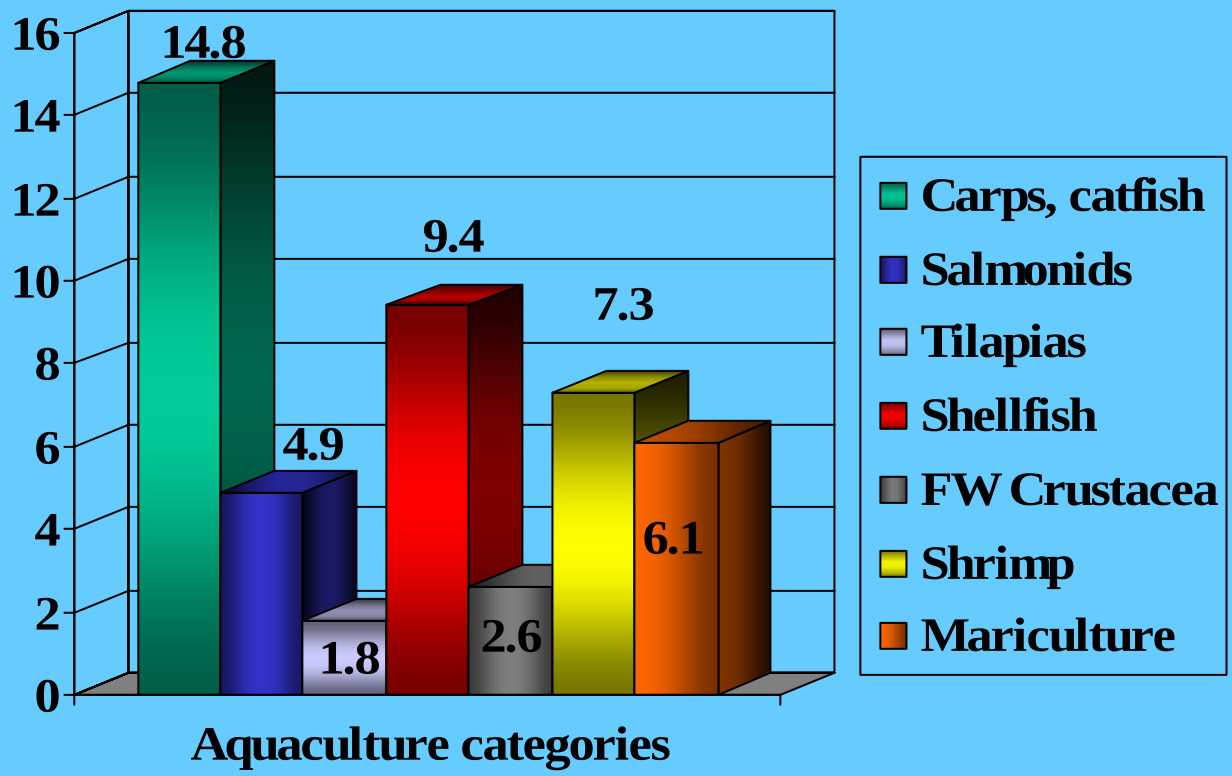


- Carps, cyprinids & catfish (16.7 Million Tonnes)
- Tilapias, other cichlids (1.5 MT)
- Miscellaneous freshwater fish (3.7MT)
- Salmon, trout, smelts (1.8MT)
- Eels (0.2MT)
- Others (2 MT)

† FAO, World aquaculture production by species

Value of Aquaculture Products - Global

Value US$ billions



† FAO, World aquaculture production by species

Fish farms - types

- Freshwater & seawater
- Numerous types in each category
- On land
  - Flow through, partial or full re-circulation
  - Tanks or ponds
- Sea
  - Suspended nets, fully submerged


23
22

Live fish transfer


Salmon farm, Bergen


Beached octagons, West Ireland


Organic Atlantic salmon –
post-smolt site, Ireland

TIC
Teo.

- Turbot


Costa Rica Tilapia


Louisiana catfish

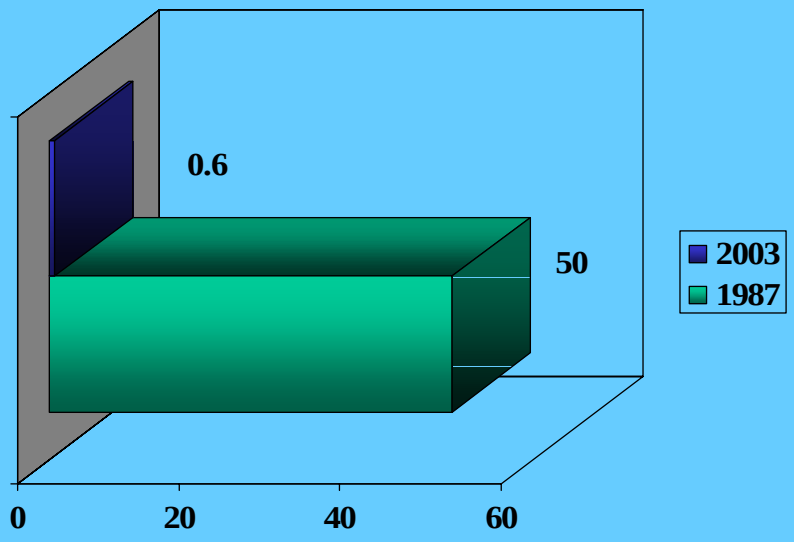

Shrimp

Vaccine interventions

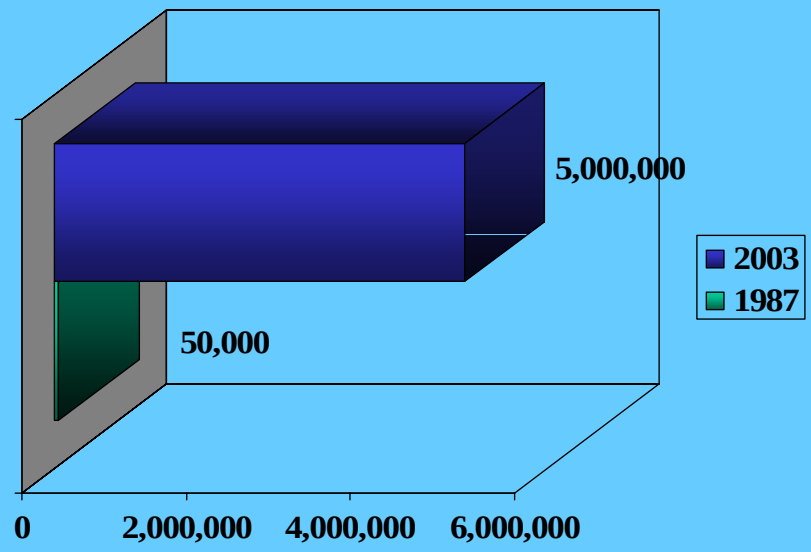
- *Vibrio* spp. USA 1970's – Immersion formalin-inactivated
- Norway *Vibrio* spp. 1980's
- Early 1990's – Furunculosis (Immersion not suitable) ⇒ injectables
- Became evident that all antigens in an oil adjuvated vaccine offered excellent efficacy ⇒ an immeadiate and permanent reduction in antibiotics & a 3-fold inrease in fish production [6.]

Salmon parr: Furunculosis

Impact of Vaccines – Norway[1].



Tonnes antibiotic used in salmon farming

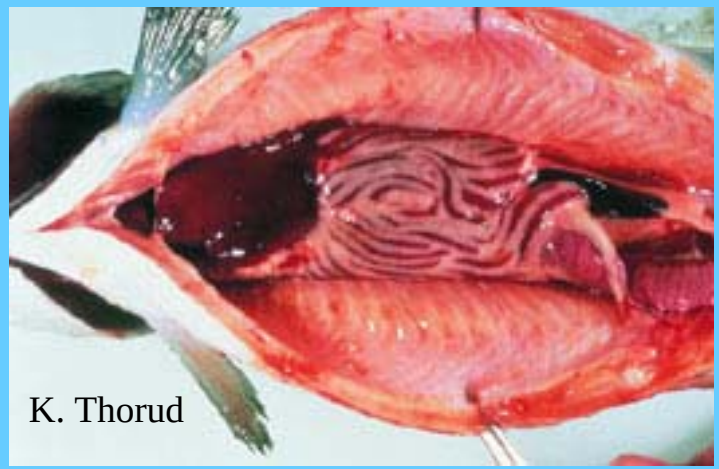


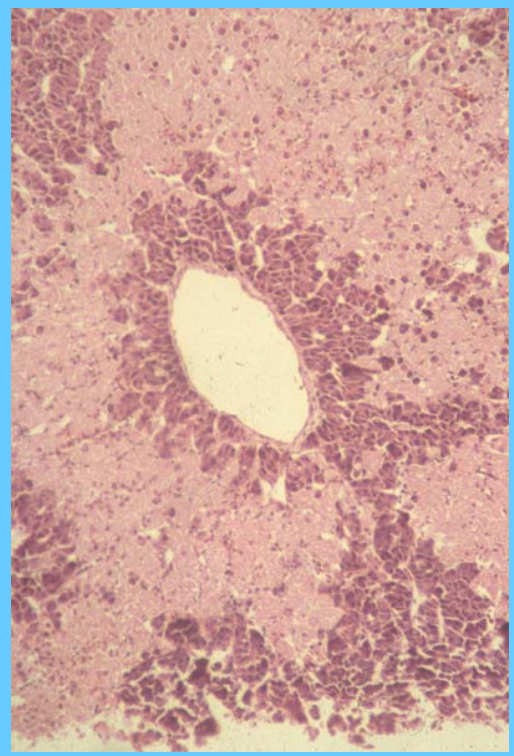
Tonnes salmon produced

1.Intervet, 2003

Viral Diseases of Economic Importance - Infectious Salmon Anaemia (ISA)

- Atlantic salmon (trout experimentally)
- Typically post-transfer
- Severe anaemia, ascites, haemorrhage
- Vaccination - Canada, equivocal
- Notifiable, List I





Infectious Haematopoietic Necrosis (IHN)

1970's from North America – single batch of RT eggs & fry?

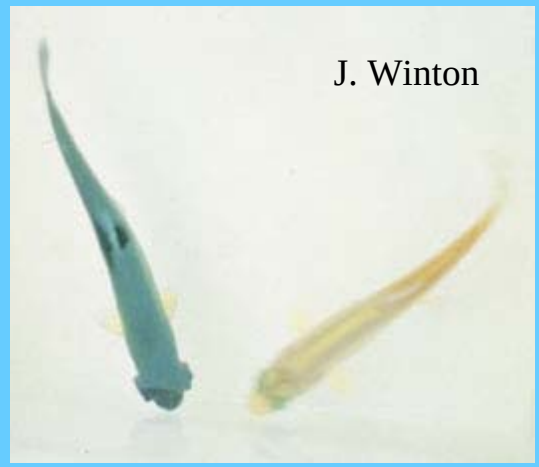
All salmonids

In Europe

Up to 100% mortality in fry

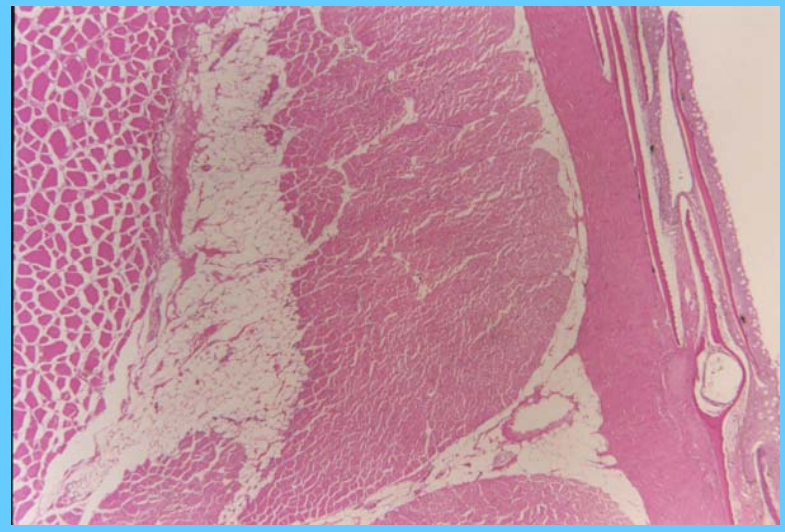
Survivors – carriers, faecal shedding

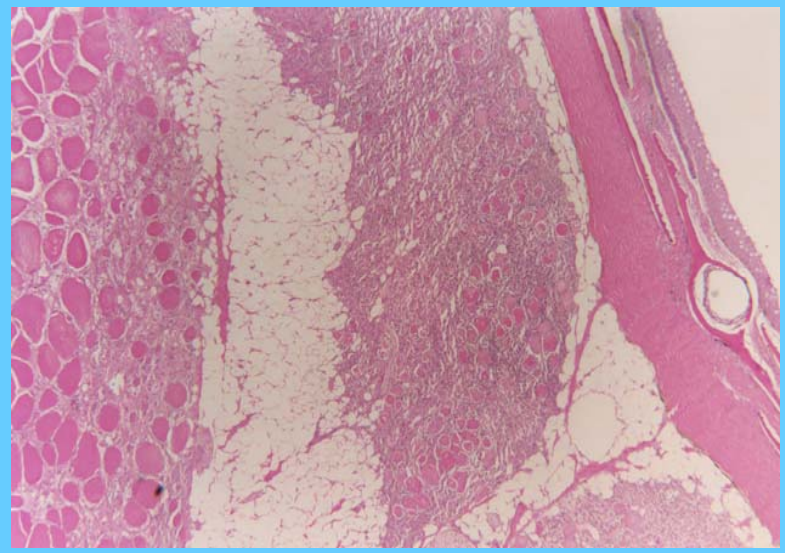
Notifiable, List II



Salmonid Alphavirus (SAV)

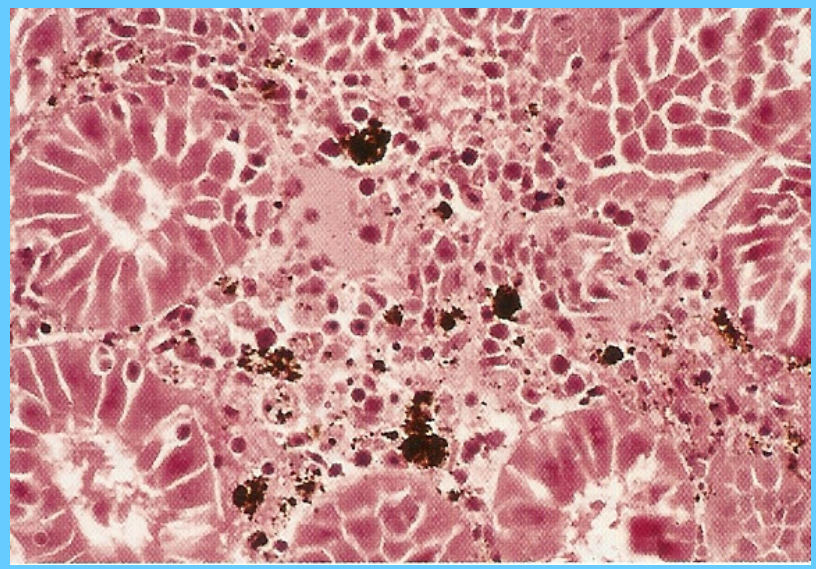
- Salmon Pancreas Disease Virus / Sleeping Disease Virus
- PD since 1976 in Scotland
- Pancreatic necrosis, subsequent necrosis of skeletal and cardiac muscles – lethargy, anorexia, faecal casts, mortalities
- Responsible for 1:8 deaths in farmed salmon that go to sea (Ireland)
- Source unknown
- Experimental licensed vaccine
- Not notifiable





Viral Haemorrhagic Septicaemia (VHS)

- Multiple species of fish SW & FW
- Rainbow trout in Europe
- Wild fish off USA and Europe
- Haemorrhages
- Nervous signs?
- Notifiable, List II



Spring Viraemia of Carp (SVC)

- Common carp the principle host
- U.K.
- Europe – experience low water temperatures
- All age groups when 10 -17°C particularly spring
- No licensed vaccines currently: List III

Infectious Pancreatic Necrosis (IPNv)

- Numerous species in many parts of the world
- Particularly salmon, Rainbow trout
- Vertical transmission
- Very robust
- Typically fry, but post-smolts recently Norway, Scotland, Ireland
- Vaccine

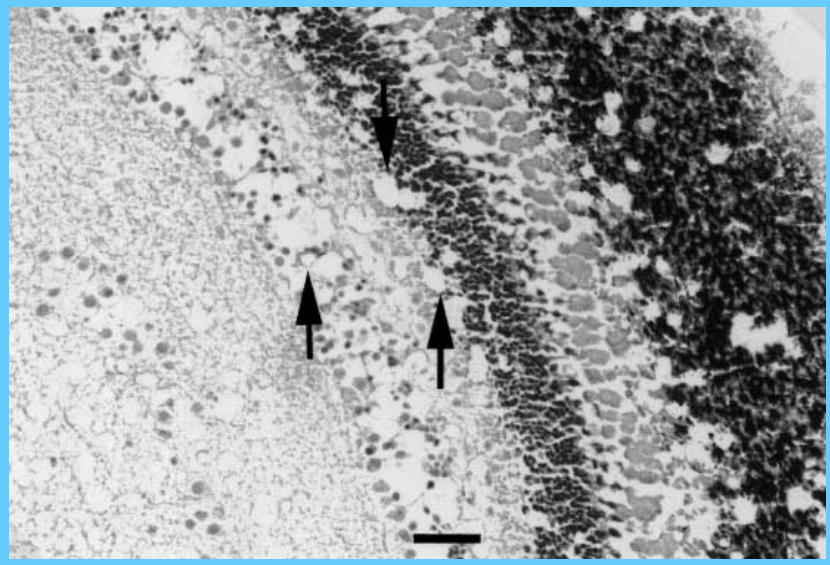
P. Varvarigos

Viral Encephalopathy and Retinopathy (VER, VNN)

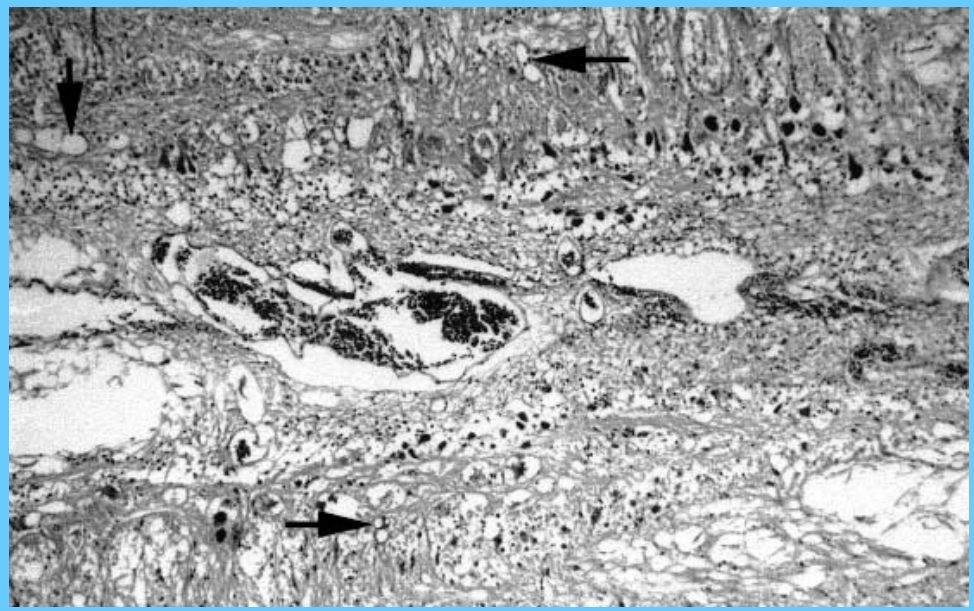
Betanodavirus

Multiple species – Sea bass

>30 countries



Retina, Bar = 50µm



Spinal Cord

Athanassopoulou *et al.*

Bacterial Diseases of Economic Importance

Furunculosis:

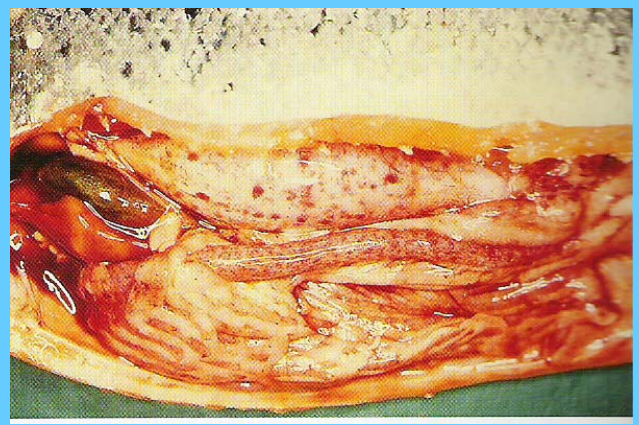
Aeromonas salmonicida

Vibriosis:

Vibrio salmonicida “Cold Water Vibriosis”

Listonella (Vibrio) anquillarum

Moritella (Vibrio) viscosa



Bacterial Diseases of Economic Importance

Piscirickettsiosis: *Piscirickettsia salmonis*

Enteric Red Mouth: *Yersinia ruckerii*

Bacterial Diseases of Economic Importance

- Bacterial Kidney Disease *Renibacterium salmoninarum*

- Rainbow Trout Fry Syndrome (RTFS) / CWD
- Utilizing heat-killed extracts, outer membrane extracts & lipopolysaccharides amongst others[4].

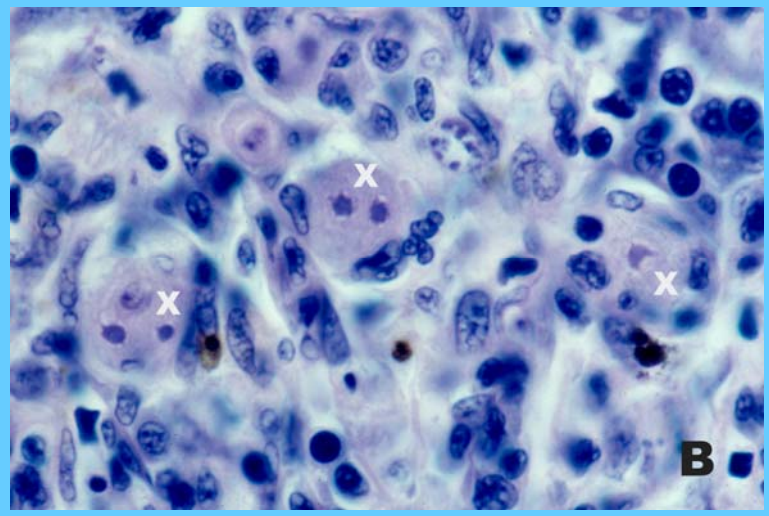
Parasites of Economic Importance - Sea Lice

- *Lepeophtheirus salmonis*
- *Caligus elongatus*
- On-going research into vaccines
- Preparing a sea lice cDNA library[5].

• Identifying genes of interest as vaccine candidates – injecting recombinants

Proliferative Kidney Disease (PKD)

- *Tetracapsuloides bryosalmonae*
- SPAH & Defra funded work in IoA [3.]
- Antigen in several different species of myxozoa
- Developing an expression library
- Sequence the antigen
- Vector (prokaryotic)
- Harvest the protein as potential vaccine



Emerging Diseases

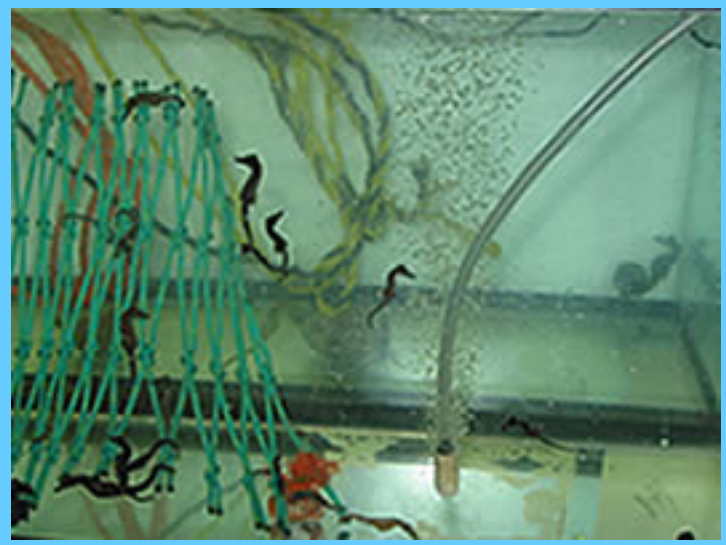
- Koi Herpes Virus / Carp Nephritis and Gill Necrosis Virus
- 18 – 27°C
- Attenuated vaccine Israel

- Heart and skeletal muscle inflammation virus (HSMI)
- Similar to SPDV
- Identification imminent?

- Iridovirus:Epizootic Haematopoietic Necrosis (EHN): Australia
- Two related viruses (European Sheatfish and European Catfish Viruses) present in Europe

Emerging trends

Seahorse Ireland & Cod hatchery, Carna, Co. Galway



Increased trend towards organic farming in salmonid culture ⇒ fewer antibiotics

Feed technology – plant protein

Oceanic farming?

Ocean Spar

References & Acknowledgement

1. Athanassopoulou *et al.*,Viral encephalopathy and retinopathy of *Dicentrarchus labrax* (L.) farmed in fresh water in Greece. J. of Fish Dis.2003, **26**, 361-365
2. Biering *et al.* Update on viral vaccines for fish. In: *Fish Vaccinology, Developments in Biologicals.* Midtlyng PJ (Ed.), 2005
3. Charles McGurk, Institute of Aquaculture, University of Stirling
4. Alison Morgan, Institue of Aquaculture, University of Stirling
5. Grace Mulcachy, Elaine McCarthy, Department of Parasitology & Microbiology, Faculty of Veterinary Medicine, UCD
6. Sommerset *et al.*, Vaccines for Fish in Aquaculture, *Expert Rev. Vaccines 4(1), 2005*

7. Acknowledgements:

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