Finfish News

(incorporating Trout News)

Number 2, Summer 2006

Cefas

CENTRE FOR ENVIRONMENT, FISHERIES AND
AQUACULTURE SCIENCE

FINFISH NEWS

Incorporating Trout News

Number 2
Summer 2006

Cefas is an Executive Agency of the Department for Environment, Food and Rural Affairs (Defra)

Many thanks to Stuart Minnikin for the picture of the brown trout on the front cover.
www.yorkshire-dales-flyfishing.com

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- Articles, letters and news relating to farming of trout and other food fish and the production of coarse and coldwater ornamental fish are welcome and should be sent to the editor. The deadline for the next issue is Friday 1st December 2006.

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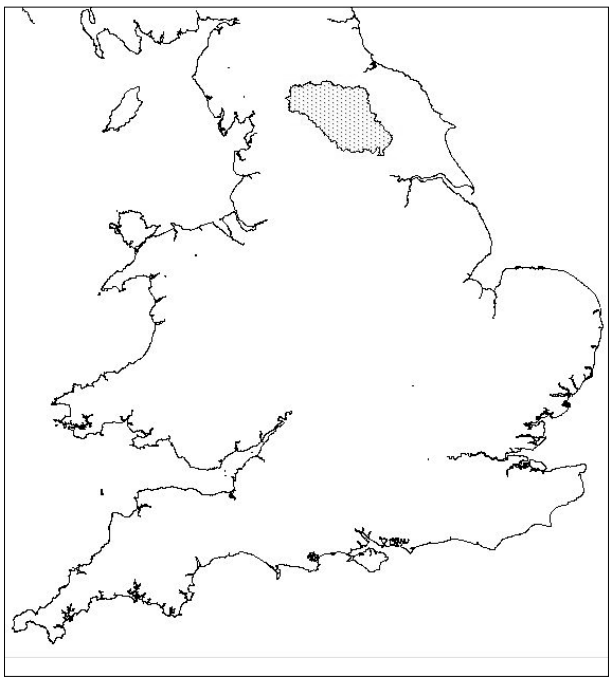
* Due to commitment of resources to the Viral Haemorrhagic Septicaemia (VHS) and Bacterial Kidney Disease (BKD) situations, the annual updates on trout production and the activities of the Cefas Fish Health Inspectorate have been deferred to the following edition of *Finfish News.*

VHS IN YORKSHIRE

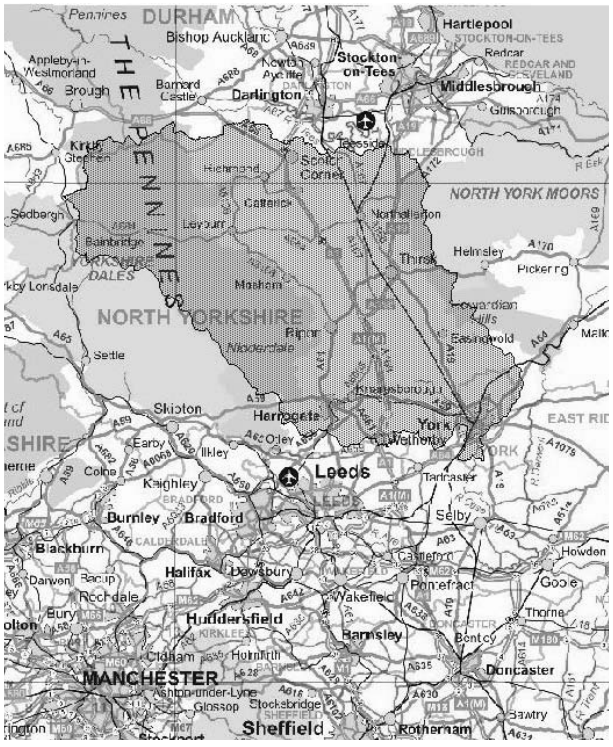
VHS National Control Centre, Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset, DT4 8UB

Most readers should by now be aware that the virus responsible for the disease Viral Haemorrhagic Septicaemia (VHS) was detected in rainbow trout at a fish farm in Yorkshire in May of this year. VHS is a notifiable disease in the UK and a List II disease under European Directive 91/67/EEC.



The fish farm had been experiencing abnormal mortalities of trout for a number of weeks which private fish health specialists believed were due to Enteric Redmouth disease (ERM). However, when the fish failed to respond to treatment for that disease the farmer contacted the Fish Health Inspectorate (FHI) at the Cefas Weymouth Laboratory. A FHI inspector visited the farm on 22nd May and a sample of fish was collected and marked for priority analysis, as is standard procedure whenever such problems are notified to us.

VHS was confirmed by the virology diagnostics team at Cefas Weymouth Laboratory late afternoon on Friday 26th May. Defra/Cefas contingency plans to respond to major fish disease emergencies were activated by Cefas as soon as VHSV confirmation was obtained. As part of these plans, a National Control Centre (NCC) was immediately established at Cefas Weymouth to implement the plan and manage the situation. The NCC committee had its first meeting on the morning of Saturday 27th May and met several times over the Bank Holiday weekend to provide strategic control and co-ordination of the field and laboratory investigations. It has since met on an almost daily basis.



The redefined area of the river catchment of the Yorkshire Ouse (controlled area)

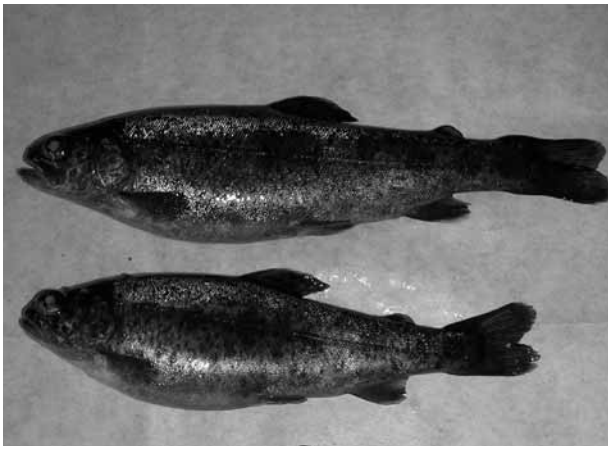
The first requirement was to inform the affected farm and to identify and contact all farms in the area, working through those with direct business links but including all farms in the river catchment in which the affected farm is situated, the Yorkshire Ouse. Temporary (30 Day Notice) controls were immediately placed on all these farms, 33 in total, preventing all fish movements onto and off the sites pending results of VHSV tests to be carried out on their stocks. In this, and for later decision-making and analysis, the FHI Live Fish Movements Database

was an invaluable aid. This is a powerful interactive electronic database, operated jointly by Cefas, the Environment Agency, Defra and Welsh Assembly Government, on which records are kept for all registered farms and other sites holding live fish, including fisheries. It contains information on fish movements (imports, internal farm transfers and introductions to inland waters) and has a valuable mapping and report generating facility. It thus allows for a speedy and accurate response to help the decision making process in preventing the spread of fish disease during major outbreaks.

Once the positive identification of VHS was confirmed, arrangements were made to put in place wider controls on fish movements and FHI field inspectors were sent to assess the situation at the known infected farm and neighbouring farms at greatest risk of being or becoming infected.

Due to the serious nature of a VHS outbreak it is necessary, under the EU fish health regime, to suspend the GB Approved Zone status for VHS and to place controls on entire river catchments on confirmation of the disease. As part of this process Defra issued a Designated Area Order under the Diseases of Fish Act 1937, prohibiting movements of fish to and from the catchment of the River Ouse. Movement restrictions were also placed on three primary contact sites outside the area pending sampling and testing. Agreement was also reached with the owner to clear all fish from the infected farm. These were humanely killed on site and transferred in sealed containers to an approved plant for rendering and incineration as dangerous waste, under strictly controlled conditions according to animal by-products legislation. The site was placed under strict biosecurity arrangements and plans were also prepared to disinfect the farm under FHI supervision.

A programme was then drawn up to visit and sample the other 33 farms in the Ouse catchment; to assess the geographical extent of the outbreak. In support of this, wild fish (brown trout and grayling) were also sampled from the river upstream and downstream of the infected site. This is because there is a concern that wild fish could have picked up VHSV shed from fish in the infected farm and carry it to other farm sites or act as a source to infect any stocks re-introduced to the affected farm at a later date.



Symptoms of VHS include swollen eyes, dark colouration, distended abdomen and internal haemorrhaging

Diagnostic staff at Cefas Weymouth prepared themselves to receive and process the large number of samples as quickly as possible. The first round of the sampling programme was completed in the first week of June. Cefas inspectors are pleased to report that they have received excellent support and co-operation from all those involved in what are very distressing circumstances for the industry. A meeting with the industry was held in Yorkshire

About 19 tonnes of fish were humanely destroyed and pumped into a skip for removal and disposal in accordance with Animal By-Products legislation, as a first step to eradicate the disease from the infected site

Disinfection of the vehicle, prior to removal of the slaughtered fish for rendering and incineration

on 9th June to explain the controls that have been put in place and the reasons for them. Implications for the future were also discussed.

VHSV has been detected in wild grayling sampled from the River Nidd in close proximity to the infected site, but nowhere else in the river. Cefas will continue to test for virus in wild fish and also examine live wild fish for VHSV covert carrier status (making them a possible reservoir of infection), by co-habitation trials with farmed rainbow trout, under bio-secure laboratory conditions.

On the basis of the intensive investigations carried out during the summer and a second round of testing that proved negative for VHSV the area subject to movement restriction was redefined on 10 August to include the catchment area of the River Ouse from its source to the Normal Tidal Limit at Naburn Lock and Weir (this area includes the rivers Nidd, Ure and Swale). All farms in the catchments of the rivers Derwent, Rye, Wharfe, Aire, Calder, Don and Rother were freed from movement restriction as a consequence. A buffer zone, which will be subject to surveillance and sampling, was also established between the redefined River Ouse and the other catchments.

Fish farmers in these areas have been asked to co-operate fully with enhanced surveillance and additional risk mitigation measures that have been put in place. Farmers in the rest of GB have also been asked to be extra vigilant and report any escapes of rainbow trout and any unusual signs of disease as they occur. Details of the measures are given in David Mullin's letter to interested parties of 10 August 2006 (available on the efishbusiness web site).

As a result of the redefinition, the suspension of the Great Britain approved zone in respect of VHS was lifted, except for the redefined River Ouse area, to enable trade to recommence from farms and other establishments falling outside this redefined area.

The question most frequently asked by the industry is where did the disease come from. As part of the epidemiological investigations that Cefas automatically undertakes in all cases of a serious disease outbreak we are investigating all possible sources of the outbreak.

VHS is a serious disease, principally of farmed rainbow trout, but all trout species are susceptible. It can cause up to 80% mortality in farmed stocks. Symptoms include darkening of the body, swollen eyes (exophthalmia), distended abdomen and haemorrhaging at the vent and bases of the fins. Fish may become moribund and congregate around the pond outlets and sides. They may also show erratic swimming behaviour such as darting, spiralling and swimming on their sides. Internally signs include haemorrhaging on the surfaces of the visceral fat and internal organs and throughout the muscle, with accumulation of fluid in the abdominal cavity. If farmers note the appearance of symptoms similar to those described above in their stock they should contact the Cefas Fish Health Inspectorate immediately for further advice (01305 206673/4). This is a legal requirement.

Further more detailed information on VHS, the latest situation on the current outbreak and advice on biosecurity is available on the eFishBusiness web site (http://www.eFishBusiness.co.uk):

- VHS factsheet
- Twenty steps towards fish farm biosecurity – Information leaflet
- Keep your fishing equipment clean - Information leaflet
- Viral Haemorrhagic Septicaemia (VHS) and Freshwater Fisheries

Those without Internet access can apply for printed copies of this information.

There is also information available from the Fisheries Research Services web site (http://www.marlab.ac.uk)

- Disinfection guide version IV: practical steps to prevent the introduction and minimise transmission of diseases of fish – leaflet
- Viral Haemorrhagic Septicaemia (VHS) – leaflet
- Risks to Wild Freshwater Fisheries from Viral Haemorrhagic Septicaemia (VHS) – Report
- Viral Haemorrhagic Septicaemia – web page

NEW AND EMERGING DISEASES IN FISH IN ENGLAND AND WALES

Stephen Irving, Stephen Feist, David Stone, David Verner-Jeffreys, Kelly Bateman, Paul Martin, Mark Thrush, Matt Longshaw, Edward Roberts, Georgina Rimmer

Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset, DT4 8UB

Cefas (Centre for the Environment, Fisheries and Aquaculture Science) Weymouth Laboratory has a responsibility (under project FC1166 from Defra) to investigate and assess the risk to cultured and wild fish stocks of new and emerging diseases. Cefas Weymouth is ideally suited for this purpose as the laboratory houses the Fish Health Inspectorate (FHI) as well as several diagnostic and research groups. In this article we describe the processes used for such investigations and give examples from some recent disease outbreaks.

Intelligence: The FHI visit all salmonid and coarse farms in England and Wales. Any reports of unusual occurrences or intelligence are therefore reported back to the laboratory. Scientific staff attend the first part of every monthly FHI meeting in order that this flow of information (reports from the field, reports from the laboratory of relevance to the field) can be exchanged. Members of the FHI also attend the monthly research project meeting where new data is discussed, plans made and priorities agreed. The Epidemiology group at Weymouth conducts a surveillance of significant new fish disease developments reported in scientific and "grey" literature throughout the world (including Internet newsletters, alerting services and news agency releases). Information on the occurrence of known diseases in new locations or species, new presentations caused by known pathogens and the appearance of new diseases is held on a database, and regular updates are provided to government laboratories in Scotland and N. Ireland, the Environment Agency and the Fish Veterinarian Society (FVS). In this way the threat from new diseases occurring in other countries can be assessed before they occur in England and Wales. In addition, the FVS has been approached to see if a mechanism whereby information from their case investigations can be included without compromising their requirement for client confidentiality.

Disease outbreaks in wild stocks are an important priority for the project. Reports of disease in wild stocks received by the Environment Agency (EA) are passed to Cefas Weymouth for investigation. In addition, samples are received from the EA's routine programme of population monitoring of wild stocks. Health status in marine fish is provided from the Fishery Liaison Officers and these are added to the database. In this way information on disease in cultured, wild, freshwater and marine fish can be used in the project.

Registry of Aquatic Pathology: Under this project the Registry of Aquatic Pathology (RAP- Fig 1) has been made available 'on-line' (http://www.aquaticpathology.co.uk). This comprehensive archive of fish and shellfish pathology contains over a thousand specimens of histological slides and parasites and is constantly being expanded as material is generated from this project and others, as well as from sources around the world.

Planning and resources: By its very nature, work on new and emerging diseases is unpredictable and can change on a weekly basis. In order to manage such a project, the decision making and information exchange processes need to be nimble and flexible. The members of the FC1166 project meet on a monthly basis with the Defra programme manager in order to discuss results and assign priorities. The ultimate aim of this rapid response approach is to collate new and emerging disease threats, identify the causative agent and its aetiology, enabling a risk assessment to be made of the risk it poses to cultured and wild stocks. Diseases which represent a threat can then be passed to other current projects for more extensive research, whilst work is terminated on those which do not represent a threat.

The following examples indicate the approaches adopted by the project team.

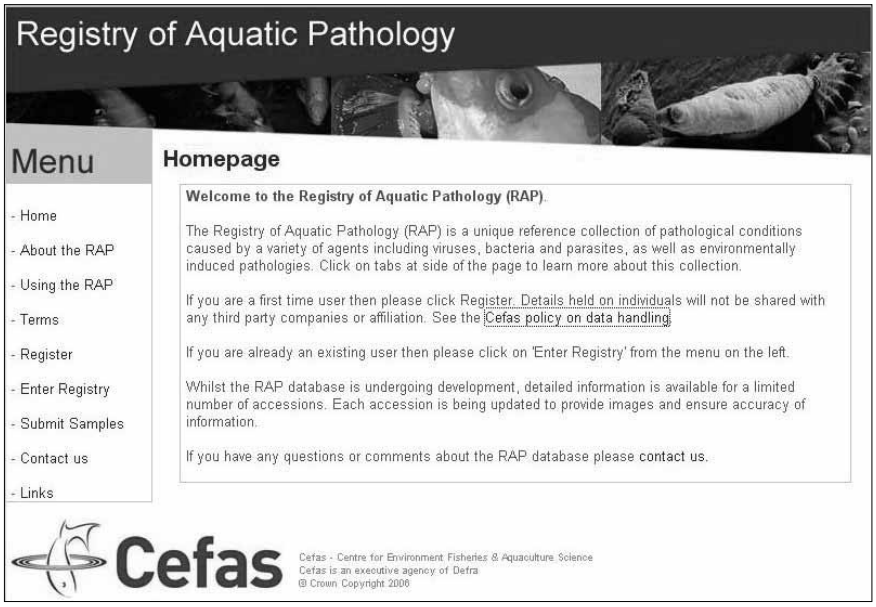


Fig 1: View of Registry of Aquatic Pathology website (http://www.aquaticpathology.co.uk).

Rosette Like Agent (RLA): This work was initiated following the discovery of an intracellular parasite termed the Rosette-like agent in sunbleak and top mouth gudgeon (TMG) as part of a scientific collaboration [(1)]. Analogy with Rosette Agent (RA – *Sphaerothecum destruens*) in the US indicated that this parasite was a potential risk to wild stocks. The publication of the article [(1)] triggered considerable media interest and briefing statements between the collaborating partners (Cefas, Defra and the Centre for Ecology and Hydrology (CEH)) were prepared. Considerable molecular biology and pathology effort has been expended on the analysis of sunbleak and TMG populations to identify the parasite (Fig 2). Following the analysis of presumed RLA free and RLA exposed populations, present data indicates that the original hypothesis (TMG carrying RLA and thereby infecting sunbleak causing their decline) appears unlikely. RLA appears to be present in sunbleak populations that have had no contact with TMG and, so far, the RLA has only been detected in populations of TMG exposed experimentally to sunbleak in recirculating systems. Further, the RLA was not consistently detected in sunbleak showing the classical wasting symptoms following exposure to TMG.

In an attempt to identify similar organisms which might also be present in UK waters, a *Dermocystidium* sp. from bullhead (obtained by monitoring of wild stocks) was sequenced and results indicated that the organism present was *D. salmonis*, a recognised parasite of salmonids. Archive material from previous reported outbreaks of *Dermocystidium* in Scottish salmon during the 1980s and 1990s was obtained. Histological and in situ hybridisation analysis of this archive material indicated that the organism from Scottish salmon (*Dermocystidium* sp.), the organism in sunbleak (RLA), and *S. destruens* from US salmon were all related members of the Class Mesomycetozoa. The RLA from sunbleak is indistinguishable from *S. destruens* using currently available techniques, but the parasite from Scottish salmon was confirmed as a *Dermocystidium* species, probably *D. salmonis*.

RA of US origin has been successfully cultured and attempts to culture RLA from sunbleak

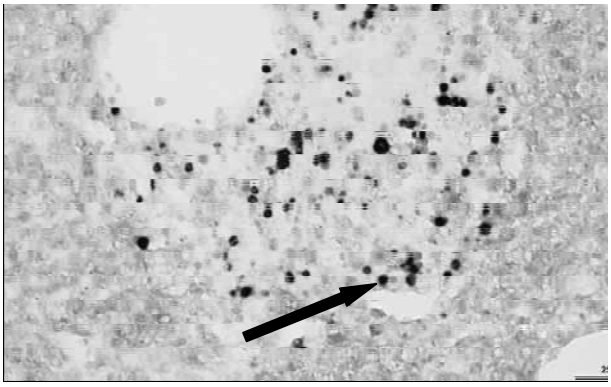


Fig 2: Detection of rosette-like agent in the liver of sunbleak using in situ hybridisation. Specific labelling of the genetic material of the organism is clearly demonstrated (⟶).

have been initiated. Present work centres on (1) identification of RLA in different populations in order to monitor its spread and assess its risk to wild UK stocks; (2) optimisation of a culture of RLA to compare with a culture of RA obtained from the US; (3) clarifying whether RLA is con-specific with *S. destruens*. Future work is in collaboration with CEH (Dorset) who will progress other aspects of work on this pathogen.

***Pseudamphistomum truncatum*:** This parasite was detected in otter (initially) and mink (subsequently) road kills [(2)]. The authors suggested that TMG or sunbleak as invasive species, could have a role in the spread of this parasite, despite these fish species never having been reported as hosts of *P. truncatum*. Analysis of 3 samples of sunbleak and 2 of TMG from the area implicated as containing the parasite (the Somerset Levels) did not reveal the presence of the parasite; in fact the parasite has never been detected in fish in this country. Subsequent meetings of the Defra Human Animal Infections and Risk Surveillance Group (HAIRS - set up to monitor public health risks from animal diseases) concluded that the parasite did not present a significant public health risk. The fish host and full life cycle of *P. truncatum* remain unknown and academic institutions are pursuing this aspect.

Red Mark Syndrome: Red Mark Syndrome (RMS) is a transmissible condition of rainbow trout, characterised by the appearance of multiple ulcerated skin swellings, of varying intensity, on the flanks of affected fish [(3)]. It shares some similarities with Strawberry Disease (SD), although there are epidemiological and pathological differences between RMS and SD. The condition causes losses to farmers in that affected fish are down-graded at harvest. The condition was first noted in Scotland. In early 2005, RMS was diagnosed for the first time in fish farmed in England. Farmers in both Scotland and England report that the disease is prevalent at low temperatures (less than 15°C). Epidemiological and laboratory studies strongly suggest that the condition is caused by a pathogenic agent of long latency and that the spread of RMS can be caused by movement of infected fish. There is, as yet, no evidence of an effect on wild fish adjacent to infected farms. RMS infected fish have been used in co-habitation challenge studies during which transmission to naïve fish was achieved, although the causative agent could not be identified. Treatment with oxytetracycline has proved partially effective indicating that the condition may be of microbiological origin. However, it is also reported that, if left untreated, affected fish will often spontaneously heal themselves. A sheet illustrating the syndrome is being shown to trout farmers by the Fish Health Inspectorate as a means of better defining the prevalence of the disease across the UK. Work on attempting to identify the causative agent continues. Discussions (in the form of visits, meetings and video conferences) link Cefas with other workers on this novel syndrome at the University of Stirling, FRS Aberdeen and the British Trout Association.

Other areas of interest covered under the project are Cyprinid Herpes Virus 2 (=Goldfish Herpes Virus) and shellfish diseases. The project (now in the second of its 4 years) will continue to offer a flexible response to Defra as new disease threats to our cultured and wild stocks emerge.

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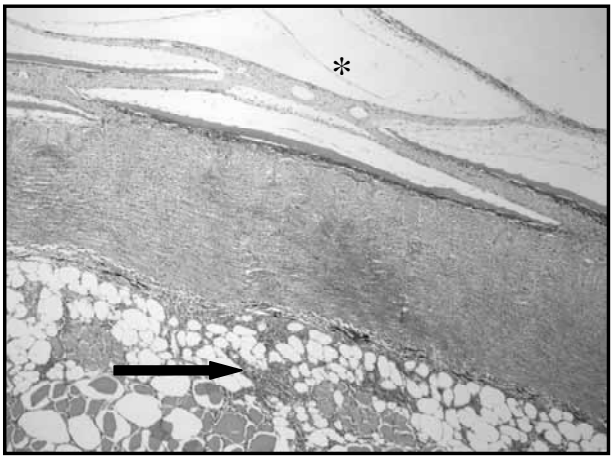

Fig 3: Histological section through the skin and muscle of a rainbow trout with mild RMS. Lifting of scales (*) with infiltration of inflammatory cells into the dermis and underlying fat and muscle tissue (⟶) can be seen.

THE ANIMAL BY-PRODUCTS REGULATION, AND RESEARCH TO SUPPORT ALTERNATIVE METHODS FOR DISPOSAL OF ANIMAL BY-PRODUCTS

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Legislation[1] on the disposal of animal by-products came into force on 1st July 2003. The legislation allocates animal by-products to one of three categories according to risk, and then specifies the means of disposal of the by-products in each category. This has changed the means of disposal of animal by-products from aquaculture. For instance, the often-used method of burial of fish mortalities followed by liming is not permitted under the regulations. Collaborative research has been carried out at the Cefas Weymouth Laboratory and at the FRS Laboratory, Aberdeen to provide data on alternative methods of disposal of aquaculture by-products by means that will inactivate pathogens that might be present. This article summarises the legislation as it relates to fish and shellfish, and the research to date.

The legislation applies to both vertebrates and invertebrates and to whole animals or parts of animals. The legislation does not apply to certain types of catering waste, wild animals (unless they are suspected of being infected with a disease that might be infectious for humans or animals) except for fish landed for commercial purposes, and it does not apply to ova, semen (milt) and embryos intended for breeding purposes.

Animal by-products are categorised into one of three groups according to the nature of the hazard. The categories are summarised below, but for clarity, only those by-products of relevance to aquaculture are listed.

The following are **Category 1** by-products (few fish or shellfish would fall into this category):

- Animals containing certain prohibited substances or environmental contaminants[2].
- Wild animals suspected of being infected with diseases communicable to humans or animals.
- Animals other than farmed or wild animals, e.g. pet animals and zoo animals.
- Animals used for experimental purposes.
- Mixtures of Category 1 material with Category 2 and/or Category 3 material.

Category 2 by-products comprise:

- Products of animal origin containing residues of veterinary drugs and high levels of certain contaminants[3].
- Animals, or parts of animals that die, other than being slaughtered for human consumption, including animals killed to eradicate an epizootic disease. This includes all mortalities occurring during the production cycle in aquaculture, as well as those animals that die from disease.
- Third country imports that fail to comply with veterinary requirements for their importation into the Community.
- By-products that cannot be classified as either Category 1 material or Category 3 material.
- Mixtures of Category 2 material with Category 3 material.

Category 3 by-products comprise:

- Parts of slaughtered animals, which are fit for human consumption, but are not intended for human consumption for commercial reasons.
- Parts of slaughtered animals, which are unfit for human consumption, but derive from carcasses that are fit for human consumption.

1 At the end of the article there are links to the Defra website, which provides more information on the legislation
2 Listed in Directive 96/22/EC or in Group B(3) of Annex 1 of Directive 96/23/EC (see Appendix)
3 Listed in Group B(1) & (2) of Annex 1 of Directive 96/23/EC (See Appendix 1)

- Fish or other sea animals, except sea mammals, caught in the open sea for the purposes of fishmeal production.

- Fresh by-products from fish from plants manufacturing fish products for human consumption.

- Shells …. originating from animals that did not show clinical signs of any disease communicable through that product to humans or animals. This is relevant to shellfish farmers.

The legislation describes the permitted methods for disposal of the animal by-products, and they are listed in Table 1. Farmers and horse owners can join the National Fallen Stock Scheme for a small fee, and their by-products are collected in a biosecure manner, and then disposed of according to the regulations. It is proposed that the scheme be expanded to include farmed fish.

Mortalities that occur during the production cycle fall into Category 2, including those animals that die from acute or chronic disease, pollution incidents, equipment failure and animals that are "poor doers" etc. Those mortalities can range from individual fish to many tonnes of fish. Hence the larger proportion of by-products on many sites may be Category 2 material. The regulations make provision for the ensiling or composting of Category 2 fish and shellfish by-products as long as it can be demonstrated that any pathogens that might be present in the by-products are destroyed by the treatment. However, no such methods specifically for aquaculture by-products are approved at present. Recognising this, Defra and SEERAD commissioned Cefas

Table 1. Permitted methods of disposal of animal by-products

Disposal Method[4]	Category of by-product
Incineration in an approved incineration plant	1, 2, 3
Rendering followed by incineration in an approved incineration plant	1,2, 3
Rendering followed by landfill	1, 2, 3
Alkaline hydrolysis	1, 2, 3
Other approved means that are developed in the light of new scientific knowledge	1, 2, 3
Rendering followed by use as a fertiliser, treatment in a biogas or in a composting plant	2, 3
Feeding of maggots for use as fish bait, providing the by-products were not derived from fish having, or suspected of having a disease communicable to humans or animals	2,3
Fish and shellfish by-products only. Ensiling or composting in accordance with procedures which have yet to be established	2, 3
Rendering followed by use in feedingstuffs (subject to restrictions e.g. on intra-species recycling of by-products)	3
Treatment in a biogas or composting plant	3
Used in an approved pet food plant	3
Transformed in an approved technical plant (i.e. a plant producing a non-food product from animal by-products	3
Ensiling followed by heat treatment	3
Burial	Pet animals only

[4] The premises, operator and equipment used for disposal of all animal by-products must be approved by Defra

Weymouth and FRS Aberdeen to undertake research to provide data on the inactivation of fish pathogens during treatment by composting or ensiling.

The brief was to undertake tests in the laboratory to determine the most resistant pathogens under laboratory test conditions, and then to test their survival following composting or ensiling under field conditions. The first task was to select pathogens for testing. A wide range of viruses and bacteria were selected, that included notifiable and non-notifiable pathogens that affect freshwater or marine fish, including Viral Haemorrhagic Septicaemia virus (VHSV), Infectious Haematopoietic Necrosis virus (IHNV), Infectious Salmon Anaemia virus (ISAV), Infectious Pancreatic Necrosis virus (IPNV), Koi Herpesvirus (KHV), Spring Viraemia of Carp virus (SVCV), *Aeromonas salmonicida, Listonella (Vibrio) anguillarum, Lactococcus garvieae, Renibacterium salmoninarum, Streptococcus iniae* and *Yersinia ruckeri*.

Exposure to formic acid at pH 4 and exposure to a temperature of 60°C were used as tests to select pathogens resistant to ensiling and composting conditions. Composting is a complex process, and conditions additional to heat contribute to the pathogen inactivation process. A temperature of 60°C was a good starting point as that is approximately the minimum temperature achieved by the composting process. A third condition, exposure to sodium hydroxide at pH 11, was also introduced as a test parameter as alkaline hydrolysis had been approved by the EU for disposal of animal by-products. The technique of alkaline hydrolysis exposes animal by-products to a high pH, at high temperature and high pressure. We tested the pathogens at high pH, but at ambient temperature and pressure as that would be a much cheaper option and more applicable to aquaculture, if it was found to be successful.

The work was divided between the two laboratories, and each was responsible for testing half the viruses and half the bacteria. Standard testing protocols were drawn up for determining the loss of infectivity of high concentrations of each pathogen that was tested at set time intervals after exposure to the chosen pH or temperature. However, before the main testing work began, both laboratories tested the same virus and bacterium under all the inactivation conditions and the results were compared. Having established that the results in the initial comparability exercise were the same for both laboratories, the testing of all the isolates commenced.

The results of the laboratory studies showed that many viruses were resistant to pH 4, and some, e.g. IPNV and SVCV, survived with little loss of infectivity for four weeks, the longest exposure time tested. Many of the bacteria were inactivated within 24 h, but *Lactococcus garvieae* survived for more than 7 days. In contrast, many of the pathogens were rapidly inactivated, some within a few seconds of exposure, by pH 11 and heating at 60°C. *Lactococcus garvieae* was the bacteria most resistant to both heat and pH 11; IPNV was the virus most resistant to heat, and ISAV was the virus most resistant to pH 11.

Representatives from each laboratory were involved in a Working Group on Aquaculture Waste R&D, chaired by Defra. The Working Group included representatives from SEERAD, Scottish Quality Salmon (now Scottish Salmon Producers Organisation, SSPO), the British Trout Association and the Sea Fish Industry Authority. The Working Group held regular meetings reviewing progress and planning the research programme.

The Working Group decided, that in the light of the knowledge emanating from the laboratory studies, not to proceed with field trials of ensiling, as a duration of longer than 4 weeks for the inactivation of fish pathogens in by-products was unacceptable for aquaculture systems. An ambient alkaline hydrolysis trial was conducted by the Cefas team using production Atlantic salmon that had died from IPNV under aquaculture conditions (i.e. not experimentally infected) to test the technology, followed later by trial of Atlantic salmon "spiked" with either ISAV or *L. garvieae*. ("Spiked" means that pathogens grown in the laboratory were added to dead Atlantic salmon, which were then processed as if they had been infected on a fish farm. This is the accepted procedure amongst scientists when naturally-infected material is not available.)

The composting field trial was done at a commercial composting site. The tested pathogens were adsorbed onto membranes

contained within a strong plastic housing (which allowed soluble material to enter the housing, but did not allow the pathogens to escape). This procedure has been used successfully with other pathogens in trials of different waste treatment systems. Several such devices were loaded into the composter with a batch of fish waste. These were removed at selected time intervals, and the membranes were tested for viable pathogens.

The ambient hydrolysis trial was conducted with 200 kg of Atlantic salmon IPN mortalities. They were put in a commercial ensiling apparatus, an equal volume of water was added and the fish tissues were macerated in the ensiler. Agricultural grade sodium hydroxide was added to provide the desired concentration, and mixed in with the fish slurry. Samples of the fish slurry were taken before addition of the sodium hydroxide, and at 24-hour intervals after its addition. The fish slurry initially contained very high amounts of IPNV (over 100 million virus particles per gram of starting tissue), and 24 h after the addition of sodium hydroxide only 1000 virus particles per gram of starting tissue were detected, i.e. 99.999% of the virus had been inactivated. Virus was not detected 48 h after the addition of the sodium hydroxide. Similar high levels of ISAV and *L. garvieae* were used in the spiking trials, and both pathogens were completely inactivated 24 h after the addition of sodium hydroxide to the spiked fish slurry.

The composting trial was also successful. The composting process takes approximately two weeks for a batch of waste to be composted, but *L. garvieae* was inactivated after 3 days and IPNV after 4 days in the composting system.

The background scientific work has now been completed and has been submitted for publication in a scientific journal. Once peer-reviewed and accepted for publication, the work will form the basis of proposals to the European Commission for alternative on-farm disposal routes for Category 2 fish by-products.

Acknowledgements:

All those who participated in the Working Group on Aquaculture Waste R&D.

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Further information:
For information on the legislation and recent developments visit the Defra website:
http://www.defra.gov.uk/animalh/by-prods/default.htm

Defra contract FC1136 and FC1157:

http://www2.defra.gov.uk/research/project_data/More.asp?I=FC1136&M=KWS&V=fc1136&SCOPE=0

http://www2.defra.gov.uk/research/project_data/More.asp?I=FC1157&M=KWS&V=1157&SUBMIT1=Search&SCOPE=0

Appendix.

A) Substances prohibited under Directive 96/22/EC

Substances having thyrostatic, oestrogenic, androgenic or gestagenic action and beta-agonists

The following are exempt: young fish treated for the first 3 months for the purpose of sex inversion with products having an androgenous action and are authorised in accordance with EU directives

B) Environmental contaminants and other substances listed in Group B (3) of Annex 1 of Directive 96/23/EC

- Organochlorine compounds including PCBs
- Organophosphorous compounds
- Chemical elements
- Mycotoxins
- Dyes
- Others

C) Appendix 3. Veterinary drugs and contaminants listed in Group B (1) & (2) of Annex 1 of Directive 96/23/EC

- Antibacterial substances including sulphonomides, quinolones
- Anthelmintics
- Anticoccidials, including nitroimidazoles
- Carbamates and pyrethroids
- Sedatives
- Non-steroidal anti-inflammatory drugs
- Other pharmacologically active substances including unlicensed substances which could be used for veterinary purposes

Full text of the Directives can be found at:

Directive 96/22/EC
http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31996L0022&model=guichett

Directive 96/23/EC
http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31996L0023&model=guichett
Consolidated Regulation:
http://europa.eu.int/eur-lex/en/consleg/pdf/1996/en_1996L0023_do_001.pdf

EFFECTS OF FISH OIL SUBSTITUTION ON THE HEALTH OF FARMED FISH

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This article has been reproduced from the Autumn 2005 edition of the *Skretting Outlook* magazine.

Over recent years a number of studies have investigated substituting a proportion of dietary fish oil with vegetable oils, by examining the effects on growth, flesh composition and consumer attitudes. This article focuses on the evidence for the absence of negative effects of dietary vegetable oils on fish health.

Fish, like all vertebrates, have requirements for essential fatty acids which, according to the habitat in which a given species has evolved, may be satisfied by specific combinations of the polyunsaturated fatty acids (PUFAs) linoleic acid (18:2n-6) and linolenic acid (18:3n-3) or the highly unsaturated fatty acids (HUFAs) EPA (20:5n-3), DHA (22:6n-3) and arachidonic acid (20:4n-6). These fatty acids are supplied to varying degrees by fish oils and/or vegetable oils and provided that the blend of oils included in the feed meets the requirements of the fish for essential fatty acids, both fish and vegetable oils can be used in the feeds for farmed fish. It has been clearly established that a substantial proportion of the fish oil currently used in salmonid feeds can be replaced using alternative edible oils without compromising the general performance and quality of the fish. A significant quantity of research has already shown that the health of the fish produced can be maintained and even, potentially improved, following partial fish oil substitution.

Fatty acids and related fat-soluble nutrients e.g. vitamin E, play a crucial role in the optimum functioning of the fish's immune system and in the maintenance of health in general. Much of the work carried out to evaluate the relationships between lipid supply and fish health has been completed using feeds with fish oil substitutions many times higher than would be applied commercially. Such studies can result in exaggerated responses by the fish but they have defined the extreme limit of fish oil substitution and have served to identify metabolic pathways and physiological processes that respond to fatty acid nutrition. The main findings can be summarised as follows:

1. Both n-3 (omega 3) and n-6 (omega 6) fatty acids have a role to play in maintaining optimum fish health.
2. Fish and vegetable oils contain different proportions of saturated, monounsaturated and polyunsaturated fatty acids (n-3 and n-6 PUFA), which, after consumption, influence the fatty acid profile of the fish. Thus, the fatty acid profile of the fish's tissues can be manipulated through the feed.
3. If provided with appropriate levels of essential fatty acids, fish are able to elongate and desaturate selected dietary fatty acids to produce the fatty acids that are needed for their metabolism but which are either absent from, or not present in sufficient quantities in, the diet.
4. Fish synthesise a wide variety of eicosanoids (highly potent "signal" and "control" molecules) e.g. prostaglandins and leukotrienes, from fatty acids. Eicosanoid families can have different potencies, which vary according to whether they are derived from n-6 or n-3 fatty acids.
5. Competition between n-3 and n-6 fatty acids for metabolic pathways means that the proportion of n-3 and n-6 derived prostaglandins can be influenced by the diet thereby influencing the control exerted by the prostaglandins over processes like immune function, smoltification and reproduction.
6. An unreasonable excess of one class of fatty acids over the other (n-6 > n-3 or n-3 > n-6) will have potential adverse outcomes for fish health since, both insufficient and excessive supply of 18C polyunsaturates, n-6 and n-3 HUFAs can be associated with adverse effects on fish well being.
7. The functioning of many components of the immune system can be influenced by the fatty acid content of the feed and the published material shows that extreme changes in fatty acid supply (both under-supply of essential fatty acids and over-supply of n-3 HUFAs), can disrupt immune function. However, moderate fish oil replacement will have no adverse effect on the effectiveness of the fish's immune response and may, indeed, be beneficially affected.
8. Subtle manipulation of the n-3/n-6 ratio can also be advantageous allowing us to influence the ratio of certain fatty acids and prostaglandins in our favour. One example of this is the potential to better prepare salmon smolts for seawater transfer by using vegetable oils as a partial fish oil substitute in freshwater feeds.
9. As poikilotherms, fish must adapt their metabolism to changes in water temperature. Part of this process is homoviscous adaptation, i.e. the modification of cell membranes to remain fluid at lower temperatures. Adaptation to lower temperatures may necessitate the incorporation of increased proportions of PUFAs into cell membranes. Being rich in PUFAs and low in saturates in comparison with most fish oils, some vegetable oils can represent more suitable lipid sources at low temperatures than fish oils.
10. The ability to influence membrane fluidity when temperatures change is important for several physiological processes. Tailoring the balance of fatty acids in the feed prior to significant temperature change, i.e. pre-emptive use of vegetable oils, will assure that the fish can quickly respond to the need for altered membrane fluidity. This could, for example, help to prevent erythrocyte fragility and assure that macrophages maintain appropriate membrane fluidity for optimum phagocytosis.
11. Fish and vegetable oils are both rich in polyunsaturated fatty acids, though the former is also rich in highly unsaturated fatty acids (≥ 20 carbon units ≥ 4 double bonds). PUFAs and HUFAs will accumulate in the fish's tissues and, being unsaturated, will increase the demand for anti-oxidants. Due to the greater unsaturation index of HUFAs, their potential for oxidation will be greater than that of an equivalent number of PUFA molecules. Consequently, the demand for antioxidant vitamins like vitamin E may be higher amongst fish fed high HUFA feeds. It is well known that a number of immune functions operate less effectively during vitamin E deficiency. Therefore when feeding high HUFA feeds more attention to vitamin E supplementation is required.

The immune response and general health of fish respond to changes in lipid supply and are strongly affected during fatty acid deficiency. Unless extreme measures are taken, the creation of fatty acid deficiency in salmon and trout feeds is extremely unlikely. Subtle changes in fatty acid nutrition result in subtle and often undetectable changes in immune response without effects on fish survival or well-being.

Unless vegetable oils are only used to partially substitute fish oils with a high n-3 fatty acid content e.g. South American fish oils, then the levels of total n-3 fatty acids in the feeds will be lower than found at present where typically, Northern Hemisphere fish oils are used. Even with some reduction in the levels of dietary n-3 fatty acids, partial fish oil substitution will not result in adverse outcomes for fish health. Indeed, as outlined above, increased levels of plant-derived PUFAs can potentially benefit physiological processes like smoltification, adaptation to low water temperatures and resistance to lipid peroxidation. If carefully controlled, partial and even complete fish oil substitution can be achieved without adversely affecting fish health. The role of the feed producer is to recognise the constraints imposed by the fish's requirements for essential fatty acids and work within them to formulate feeds that safeguard or even improve farmed fish health.

INVESTIGATIONS AND ENFORCEMENT OF FISH HEALTH LEGISLATION

Stephen Maidment, Investigations Inspector, Fish Health Inspectorate, Cefas Weymouth, Barrack Road, The Nothe, Weymouth, Dorset, DT4 8UB

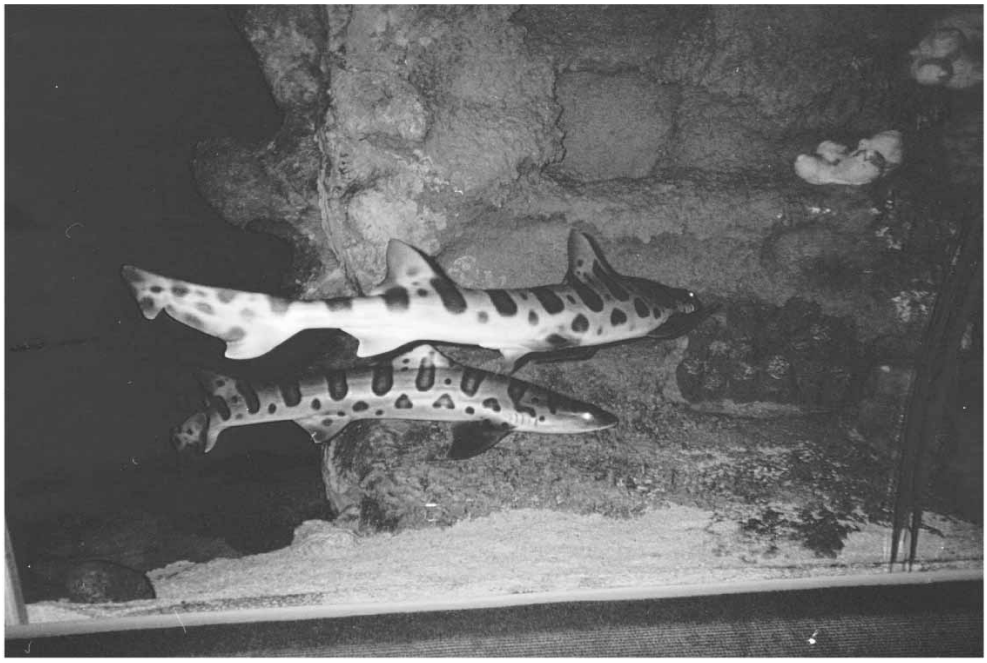
In my previous articles for *Trout News*, I emphasised the growing support across the industry for Cefas efforts to combat illegal imports of both coarse and ornamental fish. This support has continued and as a consequence the incidence of smuggling appears to have been further reduced. Whereas five or six years ago we received many reports of suspected offences we now receive very few indeed. This co-operation has taken several forms all of which combine to give cause for optimism with regard to improved fish welfare and the prevention of fish disease in England and Wales.

This process of improvement in relations across the industry was enhanced some three years ago with the formation of the English Carp Heritage Organisation (ECHO), a body of angling enthusiasts representing the interests of carp fishing. ECHO was the first organisation of its type to publicly support the work of the Cefas Fish Health Inspectorate in preventing fish diseases introduced by illegal imports. At that time the prospect of anglers actively supporting a government agency did not receive widespread approval from other groups. Since then, however, the popular angling press have contributed hugely to ECHO's success by actively supporting its aims and by publicizing its achievements.

ECHO was also the first angling organisation to contribute funds towards Cefas research, and the success of the two projects in question (into Koi Herpes Virus and Spring Carp Mortalities) proved to be a significant milestone in relations between Cefas and the angling fraternity. ECHO has moved on since then and now has the ear of government in its attempts to preserve the integrity of UK fish stocks in general and English carp in particular.

ECHO are also active members, through the Specialist Anglers Alliance, of the larger and hugely influential Fishing and Angling Conservation Trust (FACT) which was formed in 2005 and comprises most of the national coarse, game and sea angling bodies, fishery owners, tackle manufacturers and many other interested parties. Its aim is to improve standards in angling, fish welfare and fishery management, and to encourage changes to legislation. Cefas and the Environment Agency are actively involved with FACT and attend most of its meetings. Indeed a conference was held in 2005 at the Cefas laboratory in Weymouth which was attended by representatives of ECHO, FACT, Defra and the Environment Agency. Collaboration and co-operation between the industry and government agencies on this scale is a very welcome development and it is anticipated that it will act as a precursor to a united and successful campaign to improve standards across the board.

In January this year Cefas invited coarse fish farmers and dealers to a conference at Weymouth to discuss a number of important issues. One such topic was to encourage those



Photograph of some of the undersized California leopard sharks exported to the UK

present to form a representative organisation with whom Cefas and other agencies could deal. The ultimate hope was that such an organisation would formulate common standards and promote best practice. A short time prior to the conference the Coarse Fish Farmers and Traders Association (CFFTA) was formed and has formed a working relationship with the British Trout Association. (Nick Read presented a very informative and encouraging talk on the role and function of the BTA). It has also undertaken to work closely with Cefas and the EA.

Last year the government published the Hampton Review entitled '*Reducing Administrative Burdens: effective inspection and enforcement*'. Hampton made a total of 35 recommendations aimed at reducing administrative burdens on industry by promoting more efficient approaches to regulatory inspections and enforcement without compromising regulatory standards or outcomes. Emphasis was placed on the need for regulators to work more closely with industry through themed groups of interested parties to identify and overcome problems and encourage greater voluntary compliance. Another recommendation was that a risk assessment process should be put in place to govern and prioritise regulatory enforcement. Cefas has operated along similar lines for a number of years and is confident that the adoption of these recommendations will be a natural progression of its present enforcement strategy.

Although each of the above developments deals with separate individual issues it is clear that, taken as a whole, they knit together to serve as encouragement to get us all working more closely together in the interests of achieving a less burdensome enforcement regime on industry, ensuring that the highest levels of protection continue to be afforded to our native fish stocks and other aquatic wildlife, whilst developing the very best common standards and practices across the whole industry. I believe this is a unique opportunity to get it right – together.

In the meantime routine work goes on. A request for assistance was received from the US National Oceanic and Atmospheric Administration (NOAA) who were investigating the illegal taking and exporting of thousands of undersized California leopard sharks from San Fransisco Bay. (No animals under 36" can be lawfully taken). Several hundred of the sharks were exported to innocent purchasers in the UK. Nearly all were traced and evidence was obtained to facilitate the charging of the offenders in the US. We have since heard that six men, including two UK citizens, have been arrested and charged with these offences which attract a possible prison sentence of five years and a fine of $250,000.

"WORKING TOGETHER TO CONTROL DISEASE"- CONFERENCE FOR COARSE FISH FARMERS, 19TH JANUARY 2006, CEFAS, WEYMOUTH

Compiled by Keith Jeffery, Fish Health Inspectorate, Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset, DT4 8UB.

The Cefas Laboratory in Weymouth was the venue for a conference attended by coarse fish farmers from across England and Wales. The conference was organised in support of a Defra initiative to encourage the development of discussion groups in order to engage with stakeholders and trade associations when new reforms and changes in legislation were about to be introduced.

The theme for the day was "Working Together to Control Disease" and the aims of the conference were to:

- Encourage open debate, greater understanding and consensus with coarse and ornamental fish farmers on fish health issues.
- Update farmers on recent legislative changes and other issues affecting or likely to affect their businesses.
- Identify and discuss problems affecting fish farmers.
- Provide helpful and informative advice to the industry.
- Encourage the further development of the recently formed coarse fish farmers and traders association.

Guest speakers addressed issues of importance to the coarse and ornamental fish farming industry including new fish health legislation, emerging fish disease issues, the water framework directive, the role of an aquaculture development officer, codes of practice for fish farmers, and the future development of the new trade association.

Participants and speakers alike hailed the day as an outstanding success.

Eric Hudson, Head of the Cefas Fish Health Inspectorate said that "providing the fish farmers with an opportunity to tour the laboratory, learn about the work of Cefas and ask questions went a long way towards developing greater understanding and closer working with the industry. The fish farmers present voiced their thanks for this opportunity".

Bernice Brewster, chair of the newly formed Coarse Fish Farmers and Traders Association (CFFTA) thanked Cefas for organising the day and all the advice provided. She said " in future the CFFTA hope to be able to speak on behalf of farmers from across the country and to represent them in talks with government agencies on issues affecting their industry".

Conference Speakers

Changes to Fish Health Legislation

David Mullin, Defra, *Fish II A Division* (now Team "G" VEROD - Veterinary Exotic Diseases, Research & Official Controls - in Animal Health and Welfare Directorate), firstly described existing legislation. The UK has maintained a high fish health status due mostly to early national legislation, e.g. the 1937 Diseases of Fish Act. Subsequent UK entry into the European Union has meant compliance with the EU regime on fish health. Key directives have been 91/67 (concerning animal health conditions and placing on the market of aquaculture animals and products), 93/53 (introducing minimum Community measures for the control of certain fish diseases) and 95/70 (introducing minimum Community measures for the control of certain diseases affecting bivalve molluscs).

An important aspect of 91/67 was the concept of approved zones for serious fish diseases. The UK was granted approved zone status for Viral Haemorrhagic Septicaemia (VHS) and Infectious Haematopoietic Necrosis (IHN) and additional guarantees were allowed for the UK in respect of Spring Viraemia of Carp (SVC) and *Gyrodactylus salaris* (GS). In 2004, additional guarantees were granted to the UK in recognition of the efforts made to maintain freedom from GS and to eradicate SVC and Bacterial Kidney Disease (BKD). The effect of the guarantees

is that equivalent control measures to those in force in the UK have to apply to imports of susceptible species to help safeguard against the introduction and spread of GS, BKD and SVC.

In August 2005 the European Commission put forward formal proposals to the Council of Ministers for a new framework Directive to replace Directives 91/67, 93/53 & 95/70. The new proposals are designed to take account of the more diverse aquaculture industry of the EU since expansion of the Community in May 2004 to 25 Member States. The proposals introduce more flexibility to the extent that much of the detail will be determined by the secondary legislative process through the adoption of Commission Decisions in Standing Committee. This should enable Member States to respond more effectively to new disease situations. Some of the key areas in the new proposals are:

- Authorisation of fish farming businesses, which may also include dealerships and put and take fisheries. Authorisation is a further step up from registration.
- A more risk based fish health surveillance scheme. This would involve greater inspection of high-risk operations (for fish disease) and perhaps less inspection of low-risk operations.
- Expansion of TRACES centralised electronic recording system of fish movements.
- No restriction on import of non-susceptible species in respect of a particular fish disease into a Member State unless that State can prove a problem.
- Member States to be allowed to declare compartments (zones) free of a particular disease within its state.
- Changes to the diseases listed in the annex to 91/67. Member States may be allowed to have national control programmes for diseases not listed.
- Expenditure. Compensation funds for slaughter of fish may be available, though award will depend on a Member State's national policy.

Under the UK presidency good progress was made in Council working group meetings identifying areas of concern and addressing some of the major issues. Details of progress up to December 2005 are given in David Mullin's letter to interested parties of 26 January 2006 (copy available on the efishbusiness web site]. Discussion of the draft Directive is expected to continue to early Autumn 2006.

David Mullin finally referred to Council Decision 2003/858 which requires competent authorities of countries exporting live fish to the EU to complete a new animal health certificate. This certificate is complicated and has caused some difficulty for exporters. The Commission has now made a proposal for simpler certification of coldwater ornamentals and arrangements for harmonising certification for the import of tropical ornamental fish from third countries. In the meantime the import of tropical ornamentals are subject to national arrangements and may only be imported with a valid import licence. Defra will be consulting on the new proposals.

Cefas perspective on Koi Herpesvirus (KHV) & Goldfish Herpesvirus (GHV)

Kevin Denham, *Cefas Senior Fish Health Inspector*, talked on KHV. He explained that KHV is a member of the Herpes family of viruses. Three herpesviruses affect cyprinid fish:

- Carp Pox = Cyprinid Herpesvirus I (CyHV-1)
- Goldfish Herpes Virus = Cyprinid Herpesvirus II (CyHV-2)
- Koi Herpes Virus = Cyprinid Herpesvirus III (CyHV –3)

Koi herpesvirus is a highly infectious disease affecting only *Cyprinus carpio* (koi, ghost koi, common and mirror carp). No other species of fish is known to be naturally susceptible. The disease is temperature-dependent, the optimal range being 15 to 25°C.

KHV is characterised by extensive gill necrosis, which can develop from small white focal lesions to eventually involve all gill arches. The gill necrosis is often associated with secondary bacterial and fungal infection of the gill tissue. Other symptoms might involve sunken eyes, lethargic behaviour, fish lying in shallow water or on the bottom of the pond, and excessive mucus production on the skin. Internal organs appear normal.

KHV possibly emerged in Israeli carp farms during the 1990s. It was first identified and characterised in ex-Israeli koi in the USA in

1998. In the UK, it was first isolated in fish dealer stocks in 2000. Most western European countries have reported problems including Germany and Poland. Outside Europe, both Japan and Indonesia have experienced large mortalities of carp in aquaculture facilities for human consumption. In Japan, KHV has been reported from 38 out of 47 prefectures. There are published reports of the disease in South Africa and Taiwan. In the USA, KHV has been reported from 14 states. In the UK, KHV has been responsible for significant mortalities in wild carp fisheries: in 2003, KHV was reported as a problem in 6 fisheries, 4 in 2004 and 4 in 2005.

KHV is highly virulent and readily kills fish in both experimental and in natural systems but its ability to persist in the UK environment is not known as yet. Potential for latency has not yet been proven with KHV, but is known in other herpes viruses. It is thought that survivors of infection can act as carriers. The standard viral diagnostic methods of cell culture and PCR are only able to identify KHV in clinically affected fish. Antibodies can be detected in blood samples from carp previously exposed to KHV. Current research into KHV at Cefas includes: -

- The assessment of the impact of KHV on wild carp populations in the UK
- Development of improved methods to detect sub–clinical KHV
- The identification of different strains of KHV using genetic markers.

KHV is not, at present, a notifiable disease in Europe. The international organisation that has responsibility for animal diseases – The Office International des Epizooties (OIE) is currently considering listing KHV as a reportable disease. The EU is likely to follow OIE recommendation. The implications of listing KHV as a notifiable disease will have to be considered.

Keith Way, *Cefas Senior Virologist*, then described Cefas work on Goldfish Herpesvirus (GHV), which is also known as Haematopoietic virus of goldfish or Cyprinid Herpesvirus II (CyHV-2). The first outbreaks of GHV disease were in the Aichi prefecture in Japan in 1992. Further outbreaks were reported from Taiwan in 1995, USA in 1997 and Australia in 2003. Outbreaks in the UK were reported in 2003, but there were possibly earlier mortalities due to the disease in 1996.

Outbreaks of GHV disease are associated with a rise in temperature to above 15°C. Fish can become lethargic, suffer from anorexia and have pale patches on skin and gills, which can appear similar to KHV disease. Internal organs can be affected – pale liver, enlarged kidney and spleen. A characteristic feature is the presence of white nodules in and on the spleen. Mortalities can range from 20% to 100%.

In laboratory conditions GHV has been isolated in cultured koi fin cells but infectivity was lost when sub cultures were made. UK GHV isolates have been shown to be identical to isolates of GHV in Japan. Transmission studies are taking place using goldfish and Crucian carp to establish the latter's susceptibility to the disease. Cell culture grown virus has been shown to be pathogenic for goldfish. There is a need to consider transmission studies in hybrids involving goldfish as this may be a pathway for the virus to infect other species in particular Crucian and common carp.

Keith finished by outlining other emerging cyprinid viruses that are of interest:

- Carp Edema Virus (sleepy disease) - a poxvirus reported from Japan
- Corona–like viruses associated with carp diseases in Japan and S. Korea
- Myxo-like virus isolated in the UK
- Iridovirus isolated in the UK from three different cyprinid species.

Water Framework Directive

Alan Starkie, *Environment Agency,* gave an overview on the Water Framework Directive (WFD). He presented a résumé of the WFD (Directive 2000/60/EC containing 26 articles, 10 annexes and 72 pages). This directive was transposed into UK law by The Water Environment (WFD)(England and Wales) Regulations 02/01/2004. The purpose of Article 1 is "To establish a framework for the protection of inland surface waters, transitional waters, coastal waters & ground waters". It was noted that fish are specifically mentioned as one of the four biological quality elements to be used in the assessment of status.

Objectives of the directive include: protecting and enhancing the status of aquatic ecosystems,

promoting sustainable water use, and prevention of further deterioration. Article 4 states that member states shall protect, enhance and restore all bodies of surface water with the aim of achieving good surface water status at the latest after 15 years. Alan then explained that the directive specifies 5 classes of surface waters:

High (blue)	=	undisturbed
Good (green)	=	slight changes
Line of acceptability----------		
Moderate (yellow)	=	moderate deviation
Poor (orange)	=	substantial deviation
Bad (red)	=	relevant biological communities absent

The WFD definition of "Good" status for fish is that there are only slight changes in species composition and abundance from the type-specific communities.

Following the implementation of the WFD into UK law, the first task was to identify the river basin districts and competent authorities. This was then followed by a categorisation and risk assessment, which has now been completed. The next stage will be the monitoring and work programme required to produce the first River Basin Management Plans (RBMPs) by 2009, to facilitate the achievement of environmental objectives. Another research project linked to the WFD is the development, evaluation and implementation of a standardised **F**ish-based **A**ssessment **M**ethod for the **E**cological Status of European Rivers (FAME). This has now been developed with the help of 25 partners from 12 countries and covered 16 of the 25+ European eco-regions. This has resulted in the European Fish Index (EFI), which sets values and class boundaries for the model based index.

Alan concluded with his own summary that the WFD requires fish (along with other indicators) to be used to classify water bodies. He said that the EA already has good data for rivers but not for lakes. The definition of good status for fish will mean that there may be problems where non-natives are present. This could result in a series of measures to control the spread of non-native fish species in the wild.

Role of an Aquaculture Development Officer

Martin Syvret, *Seafish*, spoke on the role of the Inshore Group and Trade Associations in South West Aquaculture Development.

Martin explained that although Seafish dealt exclusively with marine fish and shellfish farmers, there were parallels with the freshwater finfish sector with respect to the formation of trade associations. He briefly described the Seafish role, which is to support the industry with advice, promote their products, and support research by funding and facilitating funding for proposals. Seafish also helps with the development of innovative equipment and new techniques, provides training courses, and assists with projects.

Martin then went on to describe two types of trade associations that had recently been established in the South West.

The first was a **Co-operative** of abalone growers. The advantages of having a Co-operative to represent a sector are that it has a simple structure and is therefore easy to manage. It provides a single focus for dealing with regulators and is more able to obtain grants and funding than an individual grower. It also provides for a good exchange of ideas and experiences, particularly with a developing industry. Workshops can be held to exchange information and discuss important issues with regulators.

The second was a **Producers' Organisation**. The Shellfish Growers South West (SGSW) producers' organisation arose as it was realised that the industry was fragmented and characterised by small producers who lacked economy of scale. This made it difficult for them to deal with major issues affecting them all, especially water quality. The growers realised that a combined voice was needed and thus SGSW was formed. The benefits are similar to those described for the Co-operative and in particular SGSW has facilitated more funding for the industry.

Experiences of establishing a single representative body for angling

Mr Heylin, *Fisheries & Angling Conservation Trust (FACT)*, outlined the benefits and problems

of creating an organisation to represent an industry sector and how his organisation has started to overcome these problems. He outlined the problems faced by individuals when considering the formation of an alliance such as time constraints, trust issues with competitors, financial implications of membership, and decisions on services provided by the organisation. The advantages, however, include increased profit, support, political influence and recognition from the marketplace. Particular importance was placed on negotiation with government. An individual's voice may be lost but an industry's voice is louder and will be heard. An industry organisation has the power to talk to government and lobby for change.

The presentation then moved onto a brief history of angling organisations, the road taken to the eventual formation of FACT, and the experiences gained. Problems exist primarily with funding, with no direct individual membership; FACT is reliant on its member groups for funds, who are also constrained by financial issues. Member groups also compete for members and funds. The lack of funding led to slow production of press releases and responses to press enquiries but mechanisms have been developed to improve this.

However, Mr Heylin believes the benefits far outweigh the problems. He believes that angling really does have one voice and that FACT can legitimately claim to represent anglers as it incorporates every major angling organisation in England and potentially Wales. FACT is now making more progress, more quickly. Mr Heylin concluded his presentation by urging the delegates to form an alliance or unite with the fledgling Coarse Fish Farmers and Traders Association to move the industry forward. His closing statement read, "In today's world you will be stronger together than you ever can be apart".

Codes of Practice for Coarse and Ornamental farmers

Ash Girdler, *Institute of Fisheries Management (IFM)*, gave a presentation on codes of practice: who wants one, who and what they should cover, and what the benefits are in terms of commercial and environmental outcomes to the suppliers and their customers. A code of practice is a set of self-regulating rules and/or best practice supported by a membership body representing an industry sector. This body must be considered competent and be able to deal with its members appropriately if the code or rules are broken. Those that would welcome a code of practice would include the Environment Agency, Cefas, the IFM, reputable suppliers and the customer.

Mr Girdler suggested that a code of practice should cover all suppliers of fish to be stocked into or removed from freshwater covered by section 30 of the Salmon and Freshwater Fisheries Act 1975. It was suggested that the content of the code of practice could be taken from other organisations and adapted to suit the requirements, but that care should be taken to consider what the customers and the regulators would like to see put in place. The discussion then moved on to the benefits to be gained from a code of conduct for the suppliers themselves, their customers and the regulators.

Mr Girdler encouraged the delegates to form/join an organisation and take up a code of practice to benefit themselves and show transparency to their customers, gaining trust and improving the image of the sector. He reiterated that if a competent body evolves that could represent the sector it needs to be robust and remember that a code of practice is to protect the world from its members and not its members from the world.

The Coarse Fish Farmers and Traders Association

Bernice Brewster, *Coarse Fish Farmers and Traders Association (CFFTA)*, explained that the association was initiated in 2005 and had the inaugural meeting in August 2005. The prime reason for setting up this association was to form a coherent group to represent the Industry. It gives legislators a focal point to consult on policy as it affects the industry, and aids the dissemination of information.

The first meeting was attended by individuals from the Industry plus representatives of the British Trout Association and the Federation of Small Businesses. It was agreed that the Association should be formed and that they should have regular meetings.

To date the creation of the CFFTA has been welcomed by Cefas, Defra and the EA. There is a working link to the BTA and they have attended the Committee for Aquaculture Research and Development (CARD), met with the EA Head of Fisheries, and agreed to meet on a regular basis.

The objectives for the future include ongoing consultation with Cefas, Defra and the EA with regard to changes in legislation, the adoption of an accreditation scheme for those in the trade and also independent health consultants, and forging stronger links with other aquaculture industries.

Membership is by application to Bernice Brewster (berniceacs@aol.com) or Ian Welby (blueroof@ntlworld.com).

Role and Function of British Trout Association

Nick Read, *Chairman of the BTA*, reviewed the trout production industry – there are approximately 300 registered farms in the UK, which are mainly owner operated. Most are specialized, producing fry and fingerling, fish for restocking, or table fish. There is approximately 17,000 tonnes of rainbow trout produced annually on farms each producing between 10 and 1000 tonnes. The industry employs approximately 600 full time staff and upstream and downstream activities employ another 1,300 full time employees. Ex-farm sales amount to approximately £32 million with the industry as a whole (including processing and angling) having an estimated turnover of £150 million.

The BTA represents 80% of the UK trout production. It liaises with EU and UK legislative & regulatory bodies, co-ordinates and funds R&D, manages the Quality Trout UK quality assurance scheme and handles issues management. It is also a member of FSAP, FEAP and administers the British Trout Farmers and Restockers Association (BTFRA). Funds for the BTA are raised from fish food manufacturers, members' levy and subscriptions, and through Quality Trout UK.

Through the Quality Trout UK scheme, the BTA has implemented a Quality System accredited by UKAS to EN45011. This standard now covers 80% of table production and 90% of the processed product; increasingly Quality Assurance (QA) is a pre-requisite for supply rather than a marketing tool. There are plans to extend this into the restocking market.

The BTA also collaborates on research and development projects on a European and UK level. For example, it has participated in

- AquaEtreat - investigating the use of agricultural waste products
- Fine-fish – a multi-species project seeking solutions to malformations in hatcheries
- Consensus - a wide-ranging programme to establish production protocols with the aim of improving perception of aquaculture processes and products in the mind of consumers.

The BTA recognizes the challenges of the future and undertakes to:

- Work with regulators to ensure the industry is represented in decision making while promoting and safeguarding the industry.
- Meet the current and future production challenges, including a selective breeding programme and cryopreservation of trout milt.
- Improve fish health and welfare
- Develop best practice

To go forward into the future Nick Read reiterated that the association should continue as is with regular reviews of aims and objectives and foster links with other areas of the Aquaculture Industry.

Benefits of a Trade Association.

Courtney Hough, *Federation of European Aquaculture Producers (FEAP)*, summarized the need for an association: sectors that are subject to regulation need an association to provide the associative response needed to serve its members. The benefits of an association are in finding solutions for regulatory issues and technical problems, representation in the market, enhancement of the image and development of the sector.

The key requirements of an association are that it should have:

- clear, precise objectives that are reflected in the statutes and actions
- a representative membership from the professional sector and from a wide

geographical area while avoiding domination by a few companies or individuals
- an adequate budget to enable the achievement of objectives and for secretarial support.

An association should focus on the requirements of its members, provide the best possible organization within the limitations of the budget, and provide excellent communications to the members, authorities, other trade bodies, press etc. Above all it needs well-motivated Executives and Management. The last key requirement is a business plan setting out the structure, ambitions and secretarial support of the association and the financial arrangements.

The benefits of a trade association are many fold; among others it improves the working conditions of the members, improves the image of the market sector through promotion of products etc, provides transparency and gives the sector a presence in the consultative 'arena'.

If the Trade Association is successful it will work for the benefit of its members, related parties, and society in general. As such it will be recognized as the voice of the sector. These conditions will allow the sector to be ahead of the game, to identify issues before they become problems, respond to developments, improve knowledge and skills, provide efficient upstream/downstream communication and develop the appropriate responses to key issues affecting the sector.

Current trends in Associations are to reduce costs and hence fees. However, there is an increasing number of meetings to attend and organize and it is increasingly difficult to maintain momentum due to the commitment required. There is an increased emphasis on communication, not only interpersonal but also in response to requests from the press etc. There is increasing consolidation within and across countries; this enables 'one' voice, a consolidated secretariat and makes political and economic sense. It does, however, require professionalism and organizational transparency.

He concluded that it is impossible to have good representation without an Association. An Association works like any other – it evolves and develops, it takes a lot of time and effort and imposes efficiency. Under-investment is simply not worth it. Basically "if you want representation, do it properly!"

Discussion sessions

Issues raised during the presentations were discussed during dedicated sessions. A summary of the questions and answers is available, together with the above report, on the eFishBusiness website (http://www.efishbusiness.co.uk/news/default.asp).

A BRIEF HISTORY OF KOI

Jon Handley, Farms Technical Advisor, Skretting, Wincham, Northwich, Cheshire, CW9 6DF

This article has been reproduced from the Summer 2006 edition of the *Skretting Outlook* magazine.

The term koi comes from the Japanese word Nishikigoi that means coloured or brocaded carp (Nishiki = coloured and goi or koi=carp). Koi are descendents of wild carp and are members of the species group *Cyprinus carpio*. Koi are generally regarded as the most beautiful of ornamental pet fish and are kept in many parts of the world.

Contrary to common belief, koi are not indigenous to Japan. They are believed to originate from eastern Asia, in the Black, Caspian, Aral Seas and China. They were introduced nearly 2,500 years ago in their black form and were known as Magoi (black koi).

The earliest written records of koi were from a Chinese book written during the Western Chin Dynasty, 265-316 AD. At that time they were described as white, red, black and blue.

During the 17th century, Japanese rice farmers in the region of Niigata Prefecture started raising Magoi as a food source. In order to make use of all available land they would terrace the mountainsides into rice paddies that were irrigated by man-made mud reservoirs sited above the paddies. The ponds filled naturally with rain and snow and were found to be ideal for growing carp fry in the summer months. The farmers began growing carp as an important

protein addition to their standard winter diet, which had tended to consist of rice and vegetables only.

The harsh winters in Niigata meant that the farmers and their families were virtual prisoners in their homes. The breeding stocks were housed in small ponds next to the house or in many instances, inside the house. This prevented losses caused by severe low temperatures. In the early days, the carp fry were produced in early June and grown on until mid-October. At this time they would be around 10 cm long. They were dried and salted prior to being stored and eaten during the winter months.

The farmers in Niigata noticed that the normally black/grey Magoi occasionally produced unusually coloured offspring and they began selectively breeding from the more colourful fish. Several solid coloured varieties were produced during this time, namely red, white and yellow but it wasn't until nearly 1830, when selective crossings of red and white fish produced the first Kohaku. More varieties followed including the Asagi and Higoi up until the late 1800's when many of the modern varieties became recognized.

At about the same time, the Leather Carp was introduced from Germany (eventually called Doitsu, meaning German). This is an almost completely scaleless carp, with skin resembling smooth leather. A cross between the Doitsu and the Asagi produced the Shusui.

It was not until 1914 that the coloured carp were seen outside of Niigata when a batch was sent to the Great Tokyo Exhibition, and some of these were made a gift to the Emperor Taisho's son. During the 1920's the Kohaku and Sanke became established, followed in the 1930's by the Shiro, Bekko, and Showa.

The koi hobby today boasts over 100 amazing colour varieties and these have mainly been developed over the last 100 years. Most have developed since World War II when almost all koi were lost in Japan due to lack of food and orders from the military to forfeit all carp to be eaten. Fortunately the core koi brood stock was hidden in secluded Shinto temple ponds. After the war the parent koi survivors were recovered and breeding began again in earnest.

Every koi is unique, and the patterns that are seen on a specific koi can never be exactly repeated. The judging of koi at exhibitions has become a refined art, which requires many years of understanding the relationship between colour, pattern, size and shape, presentation, and a number of other key traits. Collecting koi has become a hobby enjoyed by millions of enthusiasts around the world.

KOI HERPES VIRUS

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This article has been reproduced from the Autumn 2005 edition of the *Skretting Outlook* magazine.

Koi Herpes Virus (KHV) is a viral disease of common carp *Cyprinus carpio* and its ornamental varieties such as koi. The virus was first recorded in 1998, following large-scale mortalities of koi and more recently has been isolated from a number of countries throughout the world. With the growth of carp angling in the UK and the demand for larger numbers of expensive, specimen fish, the risk has risen dramatically of either introducing unhealthy fish or fish harbouring undetected KHV infections to healthy stocks. KHV has now been associated with a number of koi mortalities in England and the virus has been detected at 10 carp fisheries following mortality investigations.

The disease is believed to be highly contagious, reaching up to 90% prevalence in carp populations. This is higher than other viral carp pathogens such as Spring Viraemia of Carp (SVC). In each case the disease has occurred at water temperatures of between 17° and 23°C. With depressed immune systems, fish infected with KHV can become susceptible to secondary infections, increasing the range of symptoms that develop. Typical symptoms of KHV-infected fish have included lethargy, erratic swimming behaviour and increased mucus production. Peeling skin, usually on or around the head appearing like small patches of sunburned skin, and sunken eyes can also be symptoms. Internally, gross pathologies such as haemorrhaging within the liver and gill necrosis have also been observed.

In most cases KHV is normally introduced to a pond with the introduction of new fish. Once an infected fish is introduced it is usually just a matter of time until the temperature reaches the trigger temperature of 18°C, at which point the virus will become active and transmission will begin. Clinical signs of infection can often be observed within 14 days of exposure, but this depends on several factors.

Temperature plays a vital role in the progression of the disease: the warmer the water gets, the faster the virus will replicate and the disease outbreak will increase in speed and severity. However, when the water reaches about 25°C the virus's activity slows and, if temperatures continue to rise, then the virus starts to become latent. At this point, the fish's immune system can begin to resist the latent virus. However, even at 18°C, there are cases where KHV has failed to manifest itself as detailed above. The probable reason for this is that there are two important factors needed to trigger an outbreak:

- Temperature (18°C – 23°C)
- Stress

In some cases, even when the temperature is in the 'danger zone' it takes a stress factor to cause an outbreak of KHV. For example, one of the most common situations is that the carp suffer a parasitic infestation necessitating a therapeutic treatment. The stress caused by the administration of the parasite treatment actually causes a depression of the immune system which then triggers the KHV outbreak.

Although not currently notifiable, the Environment Agency has classed KHV as a novel pathogen in order to restrict the spread of the virus and, using Section 30 of the Salmon and Freshwater Fisheries Act, 1975, will not grant permission to stock fish into fisheries from sites known to be infected with KHV. Where a significant risk of infection exists (e.g. introduction of fish from abroad) fish will be tested for KHV using available diagnostic tools. The Environment Agency is also raising awareness of the virus to fishery owners, promoting extreme caution whenever carp are being imported or stocked into fisheries.

GOVERNMENT TESTING SHOWS VERY FEW VETERINARY MEDICINE RESIDUES IN UK FARMED FISH

The Veterinary Medicines Directorate has completed its testing of farmed fish as part of the 2005 residues programme. It has found very few residues in UK-farmed fish.

In salmon, the only residues detected were of emamectin. The fish in question were not harvested for a further 5 months and therefore these residues did not pose a risk to consumers. The fish were sampled as part of the checks on the use of ivermectin to treat sea lice. The method detects a range of substances, which includes both ivermectin and emamectin.

In trout, residues were found only in a single sample. These were residues of malachite/ leucomalachite green. A follow-up investigation found more fish with such residues and restriction orders were served. These stopped all movement of fish from the affected farm.

Overall, the industry has made great progress since Defra announced in 2002 that all use of malachite green must stop (Fig 1). It is, of course, important for all producers to continue with best practice.

This is in contrast to imported fish where residues continue to be found, most notably in 2004, when 27 of 330 samples tested positive for malachite green/ leucomalachite green residues. In all cases, Defra's Chief Veterinary Officer alerted her opposite number in the country of origin to the finding and invited them to investigate the cause of the residue. In 2005, illegal residues of malachite green/ leucomalachite green and of nitrofurans were detected in imported fish.

All of the results of the Veterinary Medicines Directorate's testing are published on its website in its 'MAVIS' house magazine (www.vmd.gov.uk). A summary of the most interesting results is included in the independent Veterinary Residues Committee's Annual Report on Surveillance for Veterinary Residues in the UK, 2005. This is due to be published in September 2006.

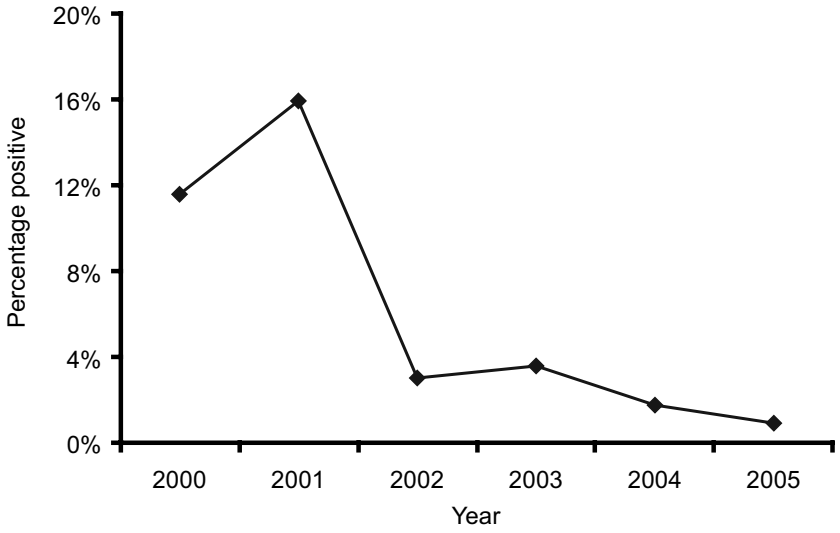


Fig 1: The percentage of trout samples that have tested positive for residues of malachite/leucomalachite green fell in 2002 when Defra announced that use must stop. Only a single trout sample tested positive in 2005.

PIONEERING "LAB ON A CHIP" TO TEST FOR MULTIPLE VIRUSES

A single test for more than 600 deadly viruses is being developed by a group of Defra funded scientists, offering the possibility of spotting a disease outbreak in hours rather than days.

The "lab on a chip", which is being led by the Central Science Laboratory near York, with £1.5m funding from Defra, will detect viruses that affect humans, animals, plants, fish and bees including avian influenza, rabies and foot and mouth.

Animal and plant researchers will be able to use the same test to identify many viruses, saving time and resources in the event of an outbreak It will also help to quickly identify when a virus has jumped from one species to another and when new strains of existing disease emerge in the future.

The biochip uses microarray technology to identify the viruses. Pieces of DNA of known viruses are attached to a glass slide and then mixed with pieces of DNA from the unidentified virus. Because matching pieces of DNA will stick together, researchers can identify the unknown virus according to which sections of the chip DNA the new DNA sticks to.

The whole process takes only from a few hours to a day and half - much quicker than traditional methods of virus testing which can take as long as 7-10 days.

Dr Ian Barker, who is leading the work to develop the chip at CSL York, said: "We're working to make the biochip sensitive enough to distinguish between diseases that have similar symptoms, such as Newcastle disease and bird flu. It will also be able to recognise the strains or subtypes of a virus, for example, H5N1 so we'll know what disease we're dealing with straight away."

Defra's Chief Scientific Adviser Professor Howard Dalton, said: "Identifying the cause of a disease outbreak is vital if we're to put the right actions in place. The biochip will help us do this much more quickly and easily, potentially enabling us to deal with future outbreaks even more effectively."

The need for improved detection, identification and monitoring of diseases over the next 10-20 years was set out in the Foresight project led by the Office for Science and Innovation which was presented to Defra in April.

FARMED FISH HEALTH MANAGEMENT

A One Day Workshop to be Held at Sparsholt College, Winchester on Friday 3 November 2006

For trout farmers especially, this Workshop is an important meeting focusing explicitly on the highly topical issue of farmed fish health management.

The Workshop will take a discussive, interactive approach to quantify causes and potential costs of fish losses and strategies to manage and improve fish health such as biosecurity, environmental management, treatments and preventatives. Small groups will analyse these crucial aspects under the direction of active fish farmers and technical experts, ensuring focused, shared discussion.

Fish farmers are most welcome to gather on Thursday 2 November 2006 for a fun evening in Winchester, very kindly supported by Schering-Plough and Skretting. The main business of the Workshop will begin on the morning of Friday 3 November 2006 at Sparsholt College, near Winchester in Hampshire.

For further information, follow the links from the Fishery Studies pages at www.sparsholt.ac.uk or contact Mark Burdass or Shaun Leonard on 01962 776441, mburdass@sparsholt.ac.uk, sleonard@sparsholt.ac.uk or Sparsholt College, Winchester SO21 2NF.

NOTE: this Workshop replaces the formerly annual British Trout Farming Conference. A Conference Steering Group met in January and, based on feedback from farmers, made the sad decision to end the Conference but instead to offer a workshop-style event to address the critical issue of health management.

FAO PUBLISH REPORT ON "THE RESPONSIBLE USE OF ANTIBIOTICS IN AQUACULTURE"

FAO Fisheries Technical Paper. No. 469. Rome, FAO. 2005. 97p.

The FAO has recently published a report on "The Responsible Use of Antibiotics in Aquaculture" to raise awareness of the antibiotic resistance problem in fish farming and related sectors and promote prudent use of these drugs according to the FAO Code of Conduct for Responsible Fisheries. The document focuses on antibiotics misuse and the concomitant threat of resistance development which is a seen as a public health concern affecting the population worldwide.

Antibiotics are drugs of natural or synthetic origin that have the capacity to kill or to inhibit the growth of micro-organisms. Antibiotics that are sufficiently non-toxic to the host are used as chemotherapeutic agents in the treatment of infectious diseases of humans, animals and plants. They have long been present in the environment and have played a crucial role in the battle between man and microbe.

Many bacterial species multiply rapidly enough to double their numbers every 20-30 minutes, so their ability to adapt to changes in the environment and survive unfavourable conditions often results in the development of mutations that enable the species to survive changing external conditions. Another factor contributing to their adaptability is that individual cells do not rely on their own genetic resources. Many, if not all, have access to a large pool of itinerant genes that move from one bacteria cell to another and spread through bacterial populations through a variety of mobile genetic elements, of which plasmids and transposable elements are two examples. The capacity of bacteria to adapt to changes in their environment and thus survive is called resistance.

Drug choices for the treatment of common infectious diseases are becoming increasingly limited and expensive and, in some cases, unavailable due to the emergence of drug resistance in bacteria and fungi – resistance that is threatening to reverse much medical progress of the past 50 years. Dissemination of resistant micro-organisms may occur in both hospitals and communities. It is recognized that a major route of transmission of resistant microorganisms from animals to humans is through the food chain.

In aquaculture, antibiotics have been used mainly for therapeutic purposes and as prophylactic agents. The contribution to antimicrobial resistance of antibiotics used in aquaculture is reviewed here, using a risk analysis framework. In the fish farming (aquaculture, mariculture, etc.) sector, the widespread use of antibiotics for treating bacterial diseases has been associated with development of antibiotic resistance in *Aeromonas hydrophila, A. salmonicida, Edwardsiella tarda, E. icttaluri, Vibrio anguillarum, V. salmonicida, Pasteurella piscida* and *Yersinia ruckeri*. In aquaculture, responsible conduct in the prudent use of antibiotics should be to reduce their use to therapeutic purposes alone; prophylactic use must be replaced by good husbandry practices, including adequate hygiene conditions and vaccination programmes. Among producers, the priority should be education programmes that emphasize proper drug use, e.g. which drugs are permitted and how to comply with HACCP protocols.

ftp://ftp.fao.org/docrep/fao/009/a0282e/a0282e00.pdf

NEWS FROM THE TRADE ASSOCIATIONS

The following articles are provided by representatives of the Trade Associations. Defra encourages the development of trade associations and discussion groups in order to engage with stakeholders. The views expressed are those of the contributors and are not necessarily those of the editors, Cefas or Defra.

THE COARSE FISH FARMERS AND TRADERS ASSOCIATION

The Coarse Fish Farmers and Traders Association was formed in 2004. A committee was elected at that time and comprised:

Chairman	-	Bernice Brewster
Vice Chairman	-	Chris Logsdon
Vice Chairman	-	Carl Francis
Treasurer	-	Simon Hughes
Secretary	-	Ian Wellby

The association was formed to represent the interests of anyone producing or selling live coarse fish in the UK. There is a very real need for a representative body such as this, particularly in light of the rapidly changing legislation controlling the movement and farming of coarse fish. One of the main purposes of this new organisation will be to represent the interests of its members as new legislation is formulated. The first major activity for the CFF&TA has been to consult with the Environment Agency on its proposals for changes in the control and consenting of fish movement within England and Wales. The "One Water One Consent" proposals have caused concern within the industry and therefore representation is essential in getting these concerns heard.

The CFF&TA has also produced codes of conduct for its members to attempt to provide some industry standards of how our members conduct their business. These codes are currently being discussed within the CFF&TA and we hope to publish them shortly.

The importance of the supply of coarse fish to the continued success of coarse fisheries within the UK is obvious; many fisheries rely on restocking to maintain the angling experience. There is also a need to introduce new stocks of coarse fish where they have been destroyed by pollution and to replenish stocks during conservation strategies for other species such as the bittern. The industry is a relatively small one but important. If anyone is interested in more information or wishes to join this new association they should contact the Chairman Bernice Brewster on 01622 815255 or the Secretary Ian Wellby on 01664 859433. The CFF&TA will be holding its AGM in August and this will be an opportunity for the membership to elect a new committee to take the association to the next step in its future.

2005 IMPORTS OF LIST II SUSCEPTIBLE SPECIES INTO ENGLAND & WALES

Following the recent expansion of *Trout News* to *Finfish News* to incorporate all finfish species, we are extending the rainbow trout egg import figures to include all salmonid egg imports (Table 1) and are including a summary of all EU imports of live List II susceptible fish species (Table 2). List II fish species are those susceptible to one or both of the notifiable diseases Viral Haemorrhagic Septicaemia (VHS) and Infectious Haematopoietic Necrosis (IHN). Such species include all salmon and trout, cod and turbot.

2005 SALMONID EGG IMPORTS INTO ENGLAND & WALES

Salmonid egg imports into England & Wales during 2005 totalled almost 23 million, 93% of which were rainbow trout eggs. This represents an increase of almost half a million on the number of rainbow trout eggs imported in 2004. The other eggs imported were brown trout and Atlantic salmon.

Table 1. Summary of salmonid eggs imported into England and Wales by month in 2005

Month	Country of origin					Total
	Ireland	Northern Ireland	Isle of Man	Denmark	USA	
January	0	0	600,000	1,460,000	200,000	2,260,000
February	100,000	50,000	1,030,000	500,000	140,000	1,820,000
March	0	0	1,100,000	1,450,000	910,000	3,460,000
April	0	0	1,045,000	425,000	140,000	1,610,000
May	0	20,000	495,000	100,000	840,000	1,455,000
June	0	0	25,000	0	1,590,000	1,615,000
July	0	0	0	0	1,320,000	1,320,000
August	0	0	0	0	2,000,000	2,000,000
September	0	20,000	170,000	0	500,000	690,000
October	0	20,000	860,000	0	1,460,000	2,340,000
November	0	0	740,000	0	760,000	1,500,000
December	0	20,000	900,000	1,725,000	0	2,645,000
Total	**100,000**	**130,000**	**6,965,000**	**5,660,000**	**9,860,000**	**22,715,000**
Total %	**0.4**	**0.6**	**30.7**	**24.9**	**43.4**	**100**

2005 EU IMPORTS OF LIST II SUSCEPTIBLE FISH INTO ENGLAND & WALES

Table 2. Summary of live List II (VHS & IHN) susceptible fish imports into England and Wales from the EU by month in 2005. Figures given as Kgs.

Month	Rainbow trout (juveniles) Northern Ireland	Cod (juveniles) Isle of Man	Turbot (adult and juveniles) France	Turbot (adult and juveniles) Isle of Man	Total
January	0	0	1151	0	1151
February	0	0	963	0	963
March	0	0	1531	26	1557
April	250	0	862	160	1272
May	0	0	1087	140	1227
June	0	0.05	1356	0	1356
July	250	0.45	1467	0	1717
August	0	0	1600	0	1600
September	0	0	1474	0	1474
October	0	8	1229	0	1237
November	0	0	1222	0	1222
December	0	0	1526	0	1526
Total (Kgs)	**500**	**8.5**	**15468**	**326**	**16302**
Total %	**3.1**	**0.1**	**94.9**	**2.0**	**100**

1. PKD susceptible trout

Proliferative kidney disease (PKD), caused by the myxozoan parasite *Tetracapsuloides bryosalmonae*, is well documented as a seasonal disease of rainbow trout. Water temperatures influence the course of the infection both within the fish and the invertebrate host, the recovery of fish from the disease being accelerated with decreasing water temperatures. During this study, groups of rainbow trout were held at a constant temperature (18°C) for a sustained period of time following initial exposure to *T. bryosalmonae*. While the majority of these fish had recovered from the clinical disease after 9 months, 10% remained infected, showing clinical signs of disease. A histological study revealed that the majority of these exhibited very high parasite loads and unusually severe symptoms of PKD. This demonstrates that while most rainbow trout can recover from PKD independent of water temperature, there exists a sub-population that cannot.

Morris, D.J. (d.j.morris@stir.ac.uk), Ferguson, H.W., Adams, A. (2005). Severe, chronic proliferative kidney disease (PKD) induced in rainbow trout *Oncorhynchus mykiss* held at a constant 18°C. *Diseases of Aquatic Organisms*, 66: 221-226.

2. Bryozoans & PKD

The myxozoan parasite *Tetracapsuloides bryosalmonae* is the causative agent of proliferative kidney disease (PKD), a highly damaging disease of cultured salmonid fish. Within this study, bryozoans were collected from a river known to be endemic for PKD and subsequently cultured in the laboratory. Developmental stages of *T. bryosalmnonae* were studied by light microscopy within the living bryozoan colonies. Infection of bryozoans resulted in the production of large numbers of spores, which were released into the water. Experimental exposure of rainbow trout to water in which infected bryozoans were cultured resulted in clinical PKD. Rainbow trout were exposed to known numbers of spores which had been released from mature spore sacs within bryozoan colonies. Exposure to a single spore was sufficient to lead to development of PKD. These findings indicate that small numbers of bryozoans are capable of releasing sufficient spores to infect large numbers of fish, having implications for future control methods for PKD in salmonid farming.

McGurk, C. (charles.mcgurk@stir.ac.uk), Morris, D.J., Auchinachie, N.A., Adams, A. (2006). Development of *Tetracapsuloides bryosalmonae* (Myxozoa: Malacosporea) in bryozoan hosts (as examined by light microscopy) and quantitation of infective dose to rainbow trout (*Oncorhynchus mykiss*). *Veterinary Parasitology*, 135: 249-257.

3. Myxozoans & brown trout

Five myxozoan species, *Tetracapsuloides bryosalmonae*, *Sphaerospora truttae*, *Chloromyxum schurovi*, *Chloromyxum truttae* and a *Myxobolus* species were detected in farmed brown trout, from Central Scotland. This study investigated the seasonal occurrence and tissue location of these species in young of the year brown trout. *C. schurovi*, *C. truttae* and *Myxobolus* sp. were first detected in brown trout in April, 2 months before *T. bryosalmonae* and *S. truttae*. *T. bryosalmonae* and *S. truttae* showed proliferation in the blood with *T. bryosalmonae* accumulating in the heart. In contrast, only small amounts of *C. schurovi* and *C. truttae* were obtained from the blood, suggesting that these species use the vascular system for transport but proliferate only in their target tissues from which large amounts were obtained and where parasites were visible in histological sections. Large amounts of *T. bryosalmonae*, *S. truttae* and both *Chloromyxum* species were obtained from the gills of brown trout, suggesting the gills as entry locus for these species. The *Myxobolus* species formed plasmodia predominantly in the peripheral nerves, possibly indicating an entry route through the skin.

Holzer, A.S. (a.s.holzer@stir.ac.uk), Sommerville, C. & Wootten, R. (2006). Molecular studies on the seasonal occurrence and development of five myxozoans in farmed *Salmo trutta* L. *Parasitology*, 132: 193-205.

4. Duplication of sleeping disease outbreak in the laboratory

Sleeping disease (SD) is a serious disease of rainbow trout reared in fresh water caused by sleeping disease virus (SDV). This study carried out a detailed clinical, histological, virological and serological description of an experimental reproduction of SD in 1-year-old rainbow trout

exposed to SDV. Two hundred disease-free fish were intraperitoneally inoculated with a SDV isolate and 100 fish were inoculated with an uninfected cell culture lysate as a negative control. SDV was detected in serum, kidney and brain of infected fish from 4 to 21 days post-infection (dpi). Characteristic pathological lesions were observed in infected fish as early as 7 dpi. Lesions were first detected in exocrine pancreas and subsequently observed in heart and skeletal muscle. Neutralizing antibodies to SDV were detected in infected fish from 14 to 70 dpi. Infected fish displayed typical signs of SD one month pi and the mortality reached 19% within 44 days. This study experimentally reproduced all the characteristics of natural outbreaks of SD in 1-year-old rainbow trout.

Boscher, S.K. (sd.k@neuf.fr), McLoughlin, M., Le Ven, A., Cabon, J., Baud, M., Castric, J. (2006). Experimental transmission of sleeping disease in one-year-old rainbow trout, *Oncorhynchus mykiss* (Walbaum), induced by sleeping disease virus. *Journal of Fish Diseases*, 29: 263-273.

5. Risk factors for *Argulus* infections

Problem infections caused by species of the crustacean ectoparasite, *Argulus*, in UK stillwater trout fisheries appear to have increased in recent years. A cross-sectional study of 77 such fisheries was conducted to establish the perceived problem and the extent and severity of this problem, and to identify associated risk factors. An interview-based study was conducted in 2001 using a standardized questionnaire based on the management and infection status of each fishery in the previous year. Logistic regression was used to identify potential risk factors. *Argulus* spp. were perceived to cause economic losses in infected fisheries through a reduction in the number of anglers due to reduced aesthetic appeal and catchability of fish. Of the sites studied, 29% experienced such a problem infection in 2000. *Argulus foliaceus* was identified in all but one case and was found to be widely distributed throughout the UK. The remaining case was identified as *Argulus coregoni*. Three risk factors were associated with problem infections: the presence of an algal bloom, slow rates of stock turnover and whether water level dropped by <1 m during the summer months.

Taylor, N.G.H. (nick.taylor@cefas.co.uk), Sommerville, C., Wootten, R. (2006). The epidemiology of *Argulus* spp. (Crustacea: Branchiura) infections in stillwater trout fisheries. *Journal of Fish Diseases*, 29: 193-200.

6. Canadian study of risk factors for ISA

Infectious salmon anaemia (ISA) is a viral disease occurring in farmed Atlantic salmon that is characterized by lethargy, anorexia, anaemia and death. To control the disease in New Brunswick, Canada, 7.5 million fish from outbreak cages have been destroyed since 1997. Despite changes made by farmers, 2002 was the worst year ever for ISA losses in the region. This study evaluated the associations between potential risk factors and ISA outbreaks in the Atlantic salmon sites in New Brunswick. The important factors identified by this study can be categorized as environmental, farmer controlled, or industry controlled according to the capacity to change or eliminate them. Environmental risk factors such as increasing the depth of the net and decreasing the depth of water underneath the net are, for the most part, dictated by site location. If there were ≥ 1000 pollock in the cage, the odds of disease in the cage increased 4.43-fold. Risk factors that are under farm control include increasing the number of times that the salmon are treated for sea lice, transferring small smolts into seawater, and improving the adaptation of smolts to seawater to reduce post-transfer mortalities. Industry-controlled factors need to be addressed by the industry as a whole. Organizing boat travel to minimize the time and frequency of boats travelling to or by sites is being reviewed and will be extremely important because visits from processing and feed delivery boats were significant risk factors. Increasing the distance between sites might also be necessary for effective control.

McClure, C.A., Hammell, K.L. (lhammell@upei.ca), Dohoo, I.R. (2005). Risk factors for outbreaks of infectious salmon anemia in farmed Atlantic salmon, *Salmo salar*. *Preventive Veterinary Medicine*, 72: 263-280.

7. The gut - a portal for pathogen entry 1?

The pathogenic bacterium *Aeromonas salmonicida* is the causative agent of the destructive disease furunculosis in salmonids. Horizontal transmission in salmonids has been suggested to occur via the skin, gills and/or intestine. The present study therefore investigated the possibility of bacterial translocation across intestinal epithelia using Ussing chamber technology, in vitro. Intestinal segments were exposed for 90 min to labelled *A. salmonicida*. Sampling from the serosal side of the Ussing chambers showed that bacteria

were able to translocate across the intestinal epithelium in both the proximal and distal regions. Plating and subsequent colony counting showed that the bacteria were viable after translocation. During the 90 min exposure to *A. salmonicida*, the intestinal segments maintained high viability as measured by electrical parameters. The distal region responded to bacterial exposure by increasing the electrical resistance, indicating an increased mucus secretion. This study thus demonstrates translocation of live *A. salmonicida* through the intestinal epithelium of rainbow trout, indicating that the intestine is a possible route of infection in salmonids.

Jutfelt, F. (fredrik.jutfelt@zool.gu.se), Olsen, R.E., Glette, J., Ringo, E. , Sundell, K. (2006). Translocation of viable *Aeromonas salmonicida* across the intestine of rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Journal of Fish Diseases*, 29: 255-262.

8. The gut - a portal for pathogen entry 2?

Flavobacterium psychrophilum is an important pathogen in rainbow trout which causes bacterial cold water disease in adult salmonids and rainbow trout fry syndrome in fry. The portal of entry for *F. psychrophilum* is not well known. In this study, the role of the intestine as a colonization site for *F. psychrophilum* was determined by evaluating the ability of high and low virulence strains to adhere to intestinal explants of rainbow trout. After incubation, samples of the gut were examined bacteriologically, histologically and by electron microscopy. The number of gut-associated *F. psychrophilum* bacteria was significantly higher for the high virulence strain than for the low virulence strain. Histological samples clearly showed numerous bacteria of the high virulence strain associated with the intestinal tissue as opposed to only a few bacteria of the low virulence strain. Additionally, extensive exfoliation of intestinal epithelium was noted after incubation with the high virulence strain, but less with the low virulence strain. These findings were confirmed using scanning electron microscopy and suggest that the intestinal epithelium might represent an important site for colonization and entry of *F. psychrophilum*.

Nematollahi, A. (anematolahi@yahoo.com), Pasmans, F., Van den Broeck, W., Ducatelle, R., Haesebrouck, F. , Decostere, A. (2005). Association of *Flavobacterium psychrophilum* strains with intestinal explants of rainbow trout *Oncorhynchus mykiss*. *Diseases of Aquatic Organisms*, 67: 67-72.

9. Vaccine for bacterial cold-water disease

Flavobacterium psychrophilum, the causative agent of rainbow trout fry syndrome and bacterial coldwater disease, causes severe economic losses in the rainbow trout farming industry. Currently the most effective method of control is antibacterial therapy as commercially licensed vaccines are not yet available. This study tested the efficacy of experimental vaccines against *F. psychrophilum* in rainbow trout under laboratory and field conditions. The mineral oil-based injection vaccines consisted of formalin- or heat-inactivated whole bacterium cell preparations. Significantly higher antibody levels in plasma were detected in vaccinated fish compared with mock-vaccinated controls. Higher survival of i.p. vaccinated fish compared to non-vaccinated fish was observed in *F. psychrophilum* challenge trials. The results suggest that mineral oil-based injectable vaccines containing formalin- or heat-inactivated virulent cells of *F. psychrophilum* triggered specific antibody production and protected the fish against bacterial cold water disease.

Madetoja, J. (jmadetoj@abo.fi), Lonnstrom, L.G., Bjorkblom, C., Ulukoy, G., Bylund, G., Syvertsen, C., Gravningen, K., Norderhus, E.A., Wiklund, T. (2006). Efficacy of injection vaccines against *Flavobacterium psychrophilum* in rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Journal of Fish Diseases*, 29: 9-20.

10. IHN virus infects trout through fins

Although Novirhabdovirus viruses, like the Infectious hematopietic necrosis virus (IHNV), have been extensively studied, limited knowledge exists on the route of IHNV entry during natural infection. This study generated a recombinant IHNV (rIHNV) expressing a bioluminescent gene which was used to infect trout. A non-invasive bioluminescence assay was used to follow virus replication in live fish after infection. The study provided evidence that the fin bases are the portal of entry into the fish. Confirmation was brought by the use of a nonpathogenic rIHNV, which was shown to persist in fins for 3 weeks postinfection.

Harmache, A., LeBerre, M., Droineau, S., Giovannini, M., Bremont, M. (michel.brecmont@jouy.inra.fr) (2006). Bioluminescence imaging of live infected salmonids reveals that the fin bases are the major portal of entry for Novirhabdovirus. *Journal of Virology*, 80: 3655-3659.

11. Handling stress promotes ulcerative disease in goldfish

In this study experimental handling stress (EHS) was applied to clinically asymptomatic farmed goldfish. EHS affected the gill and skin integrity of the fish and was accompanied by increased levels of plasma glucose, cortisol and interleukin-10 (IL-10). EHS application was followed by a highly significant infection rate with a virulent *Aeromonas salmonicida* isolate. Cumulative ulceration at the initial phase of the ensuing goldfish ulcerative disease (GUD) evidenced a facilitating role of EHS in the onset of GUD. Susceptibility to the pathogen increased from 40% in unstressed fish to 90% in the stressed fish.

Dror, M., Sinyakov, M.S. (sinyakov@mail.biu.ac.il), Okun, E., Dym, M., Sredni, B., Avtalion, R.R. (2006). Experimental handling stress as infection-facilitating factor for the goldfish ulcerative disease. *Veterinary Immunology and Immunopathology*, 109: 279-287.

12. An effective probiotic

This study recovered 125 bacterial isolates from the digestive tract of rainbow trout and carp. A culture was obtained which was effective at preventing clinical disease caused by *Lactococcus garvieae* and *Streptococcus iniae* when used as a feed additive. The culture, *Aeromonas sobria* GC2, was incorporated into the feed and fed to rainbow trout for 14 days at a dose equivalent to 5 x 10^7 cells/g of feed. When challenged intraperitoneally with *L. garvieae* and *S. iniae*, probiotic-treated groups remained healthy with total mortalities of only 0-6%, whereas untreated control groups experienced losses of 75-100%. Formalized and sonicated preparations of GC2 and cell-free supernatant fared less well. The mode of action of the probiotic reflected stimulation of innate immunity, namely an increase in number of leucocytes and enhanced phagocytic and respiratory burst activity.

Brunt, J., Austin, B. (b.austin@hw.ac.uk) (2005). Use of a probiotic to control lactococcosis and streptococcosis in rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Journal of Fish Diseases*, 28: 693-701.

13. Sodium chloride as an egg anti-fungal treatment

Saprolegniales are ubiquitous in natural water supplies of fish hatcheries, and often cause serious disease problems. This study evaluated the antifungal activity of sodium chloride, formalin and iodine by examining hatching rates of infected eggs of common carp. Different concentrations of the three compounds were tested, administered twice a day as a flush. Sodium chloride at 35 000 mg/L and formalin at 400 mg/L were found to be most effective in controlling *Saprolegnia*, with 85 and 92% hatching rates, respectively. Iodine was less effective. Sodium chloride is a safe, efficacious and economical treatment for Saprolegniosis and was therefore recommended for treating common carp eggs.

Khodabandeh, S. (saberkh@univ-montp2.fr), Abtahi, B. (2006). Effects of sodium chloride, formalin and iodine on the hatching success of common carp, *Cyprinus carpio*, eggs. *Journal of Applied Ichthyology*, 22: 54-56.

14. Sodium hypochorite as an egg anti-fungal treatment

This study tested the potential of sodium hypochlorite solution (NaOCl) to protect chum salmon eggs from water mold infection during incubation. The eggs were treated daily with NaOCl at 10 mg/L residual chlorine concentration for 15 min during their developmental period from fertilization to eyed stages. The number of infected eggs and number of eyed eggs were observed on day 23 of incubation. The percentage of infected eggs was significantly lower in NaOCl treated groups (2 -33%) than in control untreated groups (11 - 59%). The antifungal activity of NaOCl resulted in improving egg survival. The authors therefore propose NaOCl as a useful antifungal agent against water mold infection on chum salmon eggs.

Khomvilai, C., Kashiwagi, M., Sangrungruang, C. , Yoshioka, M. (motoi@bio.mie-u.ac.jp) (2006). Preventive efficacy of sodium hypochlorite against water mold infection on eggs of chum salmon *Oncorhynchus keta*. *Fisheries Science*, 72: 28-32.

15. Trial of formalin as fungal treatment in fish

Formalin has been used to treat fish egg fungal infections, but its ability to reduce mortality in fish with fungal infections has not been clearly demonstrated. In this study of the ability of formalin to reduce mortalities in rainbow trout, experimental infections with *Saprolegnia parasitica* were induced by abrasion, exposure, and temperature stress. After the exposure, the fish were randomly distributed into 16 experimental tanks (3 fish/tank). Four

treatment doses (0, 50, 100, and 150 ppm) of formalin were evaluated. Fish were given three treatments of 1 h duration: on day 1, 1 h after the fungal exposure, and then on days 3 and 5. The infection rate was 100% for all of the four trials in the study. The average percent mortality from the four trials was 67 (0 ppm), 35 (50 ppm), 29 (100 ppm), and 40 (150 ppm). The 50-, 100-, and 150-ppm doses were all lower than the 0-ppm control dose.

Gieseker, C.M. (charles.gieseker@fda.hhs.gov), Serfling, S.G., Reimschuessel, R. (2006). Formalin treatment to reduce mortality associated with *Saprolegnia parasitica* in rainbow trout, *Oncorhynchus mykiss*. *Aquaculture*, 253: 120-129.

16. Herbal antiviral treatments for VHSV

This in vitro study examined the antiviral properties of a commercial plant extract derived from olive tree leaf (*Olea europaea*) (LExt) and its major compound, oleuropein (Ole), against salmonid viral haemorrhagic septicaemia virus (VHSV). Incubation of virus with LExt or Ole before infection reduced the viral infectivity to 10 and 30%, respectively. Furthermore, when added to cell monolayers LExt drastically decreased VHSV titres and viral protein accumulation in a dose dependent manner. The authors therefore propose that *O. europaea* as a potential source of natural antivirals, which have been demonstrated to lack impact on health and the environment.

Micol, V., Caturla, N., Perez-Fons, L., Mas, V., Perez, L., Estepa, A (aestepa@umh.es) (2005). The olive leaf extract exhibits antiviral activity against viral haemorrhagic septicaemia rhabdovirus (VHSV). *Antiviral Research*, 66: 129-136.

17. Herbal *Gyrodactylus* treatment

Gyrodactylus spp. infections of commercially farmed fishes are responsible for significant economic losses. Existing treatments have proved uneconomic, stressful to the fishes, and ecologically damaging. Essential oils are naturally occurring compounds that exhibit a wide range of anti-microbial and anti-fungal activities. This study explored the possibility of using Australian tea tree oil (TTO) to treat *Gyrodactylus spp.* infection on the three-spined stickleback. In the presence of 0.01 % Tween 80 as an emulsifier, TTO treatments at concentrations between 3 and 30 ppm lowered the prevalence and reduced the parasite burden of sticklebacks naturally infected with *Gyrodactylus*. In addition, Tween 80 alone exhibited parasiticidal activity. These findings show the potential of TTO in combination with Tween 80 as a treatment for *Gyrodactylus* infection.

Steverding, D. (dsteverding@hotmail.com), Morgan, E., Tkaczynski, P., Walder, F., Tinsley, R. (2005). Effect of Australian tea tree oil on *Gyrodactylus* spp. infection of the three-spined stickleback *Gasterosteus aculeatus*. *Diseases of Aquatic Organisms*, 66: 29-32.

18. Variable noise stresses fish

Underwater noise pollution is a growing problem in aquatic environments and as such may be a major source of stress for fish. This study addressed the effects of ship noise and continuous Gaussian noise on common carp, gudgeon and European perch by measuring cortisol secretion. Underwater ship noise recorded in the Danube River and two Austrian lakes was played back to fish at levels encountered in the field (153 dB, 30 min). In a second experiment, fish were exposed to continuous Gaussian noise at a similar level (156 dB). All three species responded with increased cortisol secretion when exposed to ship noise. Interestingly, no elevation was observed when fish were exposed to continuous Gaussian noise. The results indicate that ship noise characterized by amplitude and frequency fluctuations, constitutes a potential stressor in contrast to continuous noise. Surprisingly, the data also demonstrate no apparent differences between species possessing excellent hearing abilities (hearing specialists) and species with poor hearing abilities like perch.

Wysocki, L.E. (lwysocki@umd.edu), Dittami, J.P. , Ladich, F. (2006). Ship noise and cortisol secretion in European freshwater fishes. *Biological Conservation*, 128: 501-508.

19. Fish welfare review

Human activities that potentially compromise fish welfare include anthropogenic changes to the environment, commercial fisheries, recreational angling, aquaculture, ornamental fish keeping and scientific research. There is no agreement on just how to weigh the concern for welfare of fish against the human interests involved, but ethical frameworks exist that suggest how this might be approached. Different definitions of animal welfare focus on an animal's condition, on its subjective experience of that condition and/or on whether it can lead a natural life. These provide different, legitimate, perspectives, but the approach

taken in this paper is to focus on welfare as the absence of suffering. An unresolved and controversial issue in discussions about animal welfare is whether non-human animals exposed to adverse experiences such as physical injury or confinement experience what humans would call suffering. The neocortex, which in humans is an important part of the neural mechanism that generates the subjective experience of suffering, is lacking in fish and non-mammalian animals, and it has been argued that its absence in fish indicates that fish cannot suffer. An alternative view, however, is that complex animals with sophisticated behaviour, such as fish, probably have the capacity for suffering, though this may be different in degree and kind from the human experience of this state. Recent empirical studies support this view and show that painful stimuli are, at least, strongly aversive to fish. Consequently, injury or experience of other harmful conditions is a cause for concern in terms of welfare of individual fish. There is also growing evidence that fish can experience fear-like states and that they avoid situations in which they have experienced adverse conditions.

The harm to fish welfare that results from human activities is a cost that must be minimized and weighed against the benefits of the activity concerned. Wild fish naturally experience a variety of adverse conditions, from attack by predators or conspecifics to starvation or exposure to poor environmental conditions. This does not make it acceptable for humans to impose such conditions on fish, but it does suggest that fish will have mechanisms to cope with these conditions and reminds us that pain responses are in some cases adaptive (for example, suppressing feeding when injured). In common with all vertebrates, fish respond to environmental challenges with a series of adaptive neuro-endocrine adjustments that are collectively termed the stress response. These in turn induce reversible metabolic and behavioural changes that make the fish better able to overcome or avoid the challenge and are undoubtedly beneficial, in the short-term at least. In contrast, prolonged activation of the stress response is damaging and leads to immuno-suppression, reduced growth and reproductive dysfunction. Indicators associated with the response to chronic stress (physiological endpoints, disease status and behaviour) provide a potential source of information on the welfare status of a fish. The most reliable assessment of well-being will be obtained by examining a range of informative measures and statistical techniques are available that enable several such measures to be combined objectively.

A growing body of evidence tells us that although human activities can harm fish welfare, the effects depend on the species and life-history stage concerned and are also context-dependent. For example, in aquaculture, adverse effects related to stocking density may be eliminated if good water quality is maintained. At low densities, bad water quality may be less likely to arise whereas social interactions may cause greater welfare problems. A number of key differences between fish and birds and mammals have important implications for their welfare. Fish do not need to fuel a high body temperature, so the effects of food deprivation on welfare are not so marked. For species that live naturally in large shoals, low rather than high densities may be harmful. On the other hand, fish are in intimate contact with their environment through the huge surface area of their gills, so they are vulnerable to poor water quality and water borne pollutants. Extrapolation between taxa is dangerous and general frameworks for ensuring welfare in other vertebrate animals need to be modified before they can be usefully applied to fish. The scientific study of fish welfare is at an early stage compared with work on other vertebrates and a great deal of what we need to know is yet to be discovered. It is clearly the case that fish, though different from birds and mammals, however, are sophisticated animals, far removed from unfeeling creatures with a 15 second memory of popular misconception. A heightened appreciation of these points in those who exploit fish and in those who seek to protect them would go a long way towards improving fish welfare.

Huntingford, F.A. (f.a.huntingford@bio.gla.ac.uk), Adams, C., Braithwaite, V.A., Kadri, S., Pottinger, T.G., Sandoe, P., Turnbull, J.F. (2006). Current issues in fish welfare. *Journal of Fish Biology*, 68: 332-372.

20. Oxygen injection for cage farms

A system for the injection of pure oxygen in fish cages has been developed. The delivery of oxygen is controlled using a network of oxygen sensors connected to a personal computer system to maintain a set point of dissolved oxygen in the cages. Over the last 3 years, the oxygen injection system has been tested and

optimised in commercial sized salmon cages at a research centre. At moderate oxygen deficit and temperature levels common in late summer and autumn, the system increases the oxygen concentration towards the set point. Economic appraisal shows that the value of improved growth and feed utilisation was greater than the cost of oxygen used under normal conditions in fjord based salmon cages in Southern Norway. In extremely warm periods, such as those that existed in Norway between August and October 2002, oxygen addition is vital in order to avoid mass mortality.

Bergheim, A., (asbjorn.bergheim@rf.no), Gausen, M., Naess, A., Holland, P.M., Krogedal, P. , Crampton, V. (2006). A newly developed oxygen injection system for cage farms. *Aquacultural Engineering*, 34: 40-46.

21. Barramundi growth

Temperature is recognized to be the most important environmental factor affecting growth in fish. Barramundi are cultured over a wide range of temperatures some of which approach the upper thermal tolerance for this species. This study on the growth of juvenile barramundi examined the effects of temperature ranging from the minimum optimal temperature (27°C) for growth efficiency to the extreme upper thermal limit (39°C) for feed intake, growth and growth efficiency. Juveniles (5 g) were held at four different temperatures 27, 33, 36 and 39° C and fed twice daily to satiation. Feed intake and SGR increased with increasing temperature up to 36°C. At 39°C feed intake, growth, feed efficiency ratio, protein efficiency ratio and productive energy value were significantly lower than at the other temperatures. This demonstrates that growth was optimized at temperatures from 27 to 36 °C and that barramundi have a much wider range for maximum growth efficiency than previously thought.

Katersky, R.S. (robink@utas.edu.au), Carter, C.G. (2005). Growth efficiency of juvenile barramundi, *Lates calcarifer*, at high temperatures. *Aquaculture*, 250: 775-780.

22. Selective breeding of rainbow trout 1

This study, tested the premises that 1) there is additive genetic variation for resistance to enteric redmouth disease (ERM), rainbow trout fry syndrome (RTFS), and viral haemorrhagic septicaemia (VHS); and 2) resistance to ERM and RTFS are positively correlated, while resistance to VHS is negatively correlated with resistance to the bacterial infections. Families of rainbow trout (63 full-sib from 50 sires, 38 dams) were challenged with *Yersinia ruckeri, Flavobacterium psychrophilum*, and VHS virus, the causative agents of ERM, RTFS, and VHS. The findings supported the first of the premises as additive genetic variation for resistance to ERM, RTFS, and VHS was detected. However, the second premise was not supported, as resistance to each of the diseases tended to be only weakly correlated. These findings are encouraging for commercial trout production. The additive genetic variation detected for resistance demonstrates that selectively breeding trout for resistance to ERM, RTFS, and VHS will be successful, providing a complementary approach to control these diseases. The weak genetic correlations suggest that it should be relatively easy to improve resistance to each of the diseases simultaneously.

Henryon, M. (Mark.Henryon@agrsci.dk), Berg, P., Olesen, N.J., Kjaer, T.E., Slierendrecht, W.J., Jokumsen, A., Lund, I. (2005). Selective breeding provides an approach to increase resistance of rainbow trout (*Onchorhynchus mykiss*) to the diseases, enteric redmouth disease, rainbow trout fry syndrome, and viral haemorrhagic septicaemia. *Aquaculture*, 250: 621-636.

23. Selective breeding of rainbow trout 2

The National Centre for Cool and Cold Water Aquaculture in the US is conducting a selective breeding program to improve rainbow trout for aquaculture. Two lines are being selected for improved growth. In families from both lines, a positive correlation has been found between stress responsiveness (indicated by plasma cortisol concentration after a 3-h confinement stressor) and growth performance (indicated by body weight at 300 d posthatching [dph]). In addition to stressor-induced cortisol levels, resting plasma growth hormone (GH) and insulin-like growth factor-I (IGF-I) were measured to examine the physiological and genetic bases for growth performance variation. Hormone levels were compared against two measures of growth: body weight and thermal growth coefficient (TGC). Plasma concentrations of IGF-I and GH in resting fish were not correlated with stress responsiveness and thus provided no link between stress responsiveness and the growth regulatory axis. The TGC was negatively correlated with resting plasma GH

and cortisol and positively correlated with IGF-I. The results suggest that the variation in growth performance among the broodstock families is explained, in part, by variations in resting levels of the growth regulatory and stress axes.

Lankford, S.E., Weber, G.M. (gweber@ncccwa.ars.usda.gov) (2006). Associations between plasma growth hormone, insulin-like growth factor-I, and cortisol with stress responsiveness and growth performance in a selective breeding program for rainbow trout. *North American Journal of Aquaculture*, 68: 151-159.

24. Triploids have same thermal tolerance as diploids

This study assessed the effect of ploidy on thermal tolerance in juvenile brook trout and rainbow trout in a series of tests comparing time to chronic lethal maximum (CLMax). Diploid and triploid fish were produced from a common spawn for three different groups of each species. One or two CLMax tests were performed per group, on between 15 and 50 individuals per ploidy within groups. The tests involved exposure of fish to a progressive 2°C/day water temperature increase and recording of the time at which each individual fish reached loss of equilibrium (LE). Although relative performance varied among trials, the analysis indicated overall differences due to ploidy were small and non-significant among both species. Two of the six groups included a large proportion of fish which had received a heat shock following fertilization, but were not successfully triploidized. In both cases, thermal tolerance of the heat-shocked diploids was similar to that of the non-heat shocked control diploids, indicating no persistent effect of the heat shock on thermal tolerance.

Galbreath, P.F. (galp@critfc.org), Adams, N.D., Sherrill, L.W., Martin, T.H. (2006). Thermal tolerance of diploid versus triploid rainbow trout and brook trout assessed by time to chronic lethal maximum. *Environmental Biology of Fishes*, 75: 183-193.

25. Challenges for fish nutritionists

Much of the criticism levelled at aquaculture (e.g. dependency on animal-derived feedstuffs, nutrient-laden effluent discharges, and increased organic contamination in edible products) can be traced to the feeds in use. Accordingly, finfish nutritionists are being challenged to formulate feeds that not only meet the nutritional requirements of livestock but also minimize production costs, limit environmental impacts, and enhance product quality. These challenges not only add considerable complexity to finfish nutrition but also afford opportunities to avoid some of the mistakes made by other industries in the past. From a review of the current status of finfish nutrition with respect to major nutrient classes, future opportunities and promising avenues of research are commented on. Alternative protein sources, specifically those derived from marine bycatch, plants, and microbes, are discussed, as well as methods to facilitate their implementation in finfish feeds. Dietary lipid, its role in fish bioenergetics and physiology, and quality of aquaculture products is reviewed with special emphasis on alternative lipid sources and finishing diets. Carbohydrates and fibre are discussed in terms of nutrient-sparing, least-cost diet formulation and digestive physiology. Micronutrients are reviewed in terms of current knowledge of requirements and, along with other dietary immunostimulants, are given further consideration in a review of nutriceuticals and application in finfish feeds. The status of nutritional research in new aquaculture species is also outlined. By integrating classical approaches with emerging technologies, dietary formulations, and species, finfish nutritionists may identify means to increase production efficiency and sustainability and provide for the continued success of aquaculture.

Trushenski, J.T. (saluski@siu.edu), Kasper, C.S., Kohler, C.C. (2006). Challenges and opportunities in finfish nutrition. *North American Journal of Aquaculture*, 68: 122-140.

26. Vegetable oil as a replacement for fish oil in diets

Atlantic salmon juveniles were fed either 100% fish oil (FO), 75% vegetable oil (VO), or 100% VO throughout their life cycle to harvest weight followed by a finishing diet period when all groups were fed 100% FO. The two experimental VO diets were tested at two different locations (Scotland and Norway) against the same control diet (100% FO). Flesh fatty acid profiles were measured regularly throughout the experiment, with the times of sampling determined by changes in pellet size/lipid content and fish life stage. Growth and mortality rates were not affected by dietary fatty acid compositions throughout the life cycle, except during the seawater winter period in Norway when both growth and protein utilization were increased in salmon fed 100%

VO compared to 100% FO. After the finishing diet period, the levels of typical vegetable oil fatty acids in flesh were reduced, whereas those of very long chain n-3 polyunsaturated fatty acids (VLCn-3 PUFA) increased to levels comparable with a 100% FO fed salmon. No effect on flesh astaxanthin levels was observed in relation to dietary oil source. Sensory evaluation showed only minor differences between salmon flesh from the dietary groups, although prior to the finishing diet period, flesh from 100% VO had less rancid and marine characteristics and was preferred over flesh from the other dietary groups by a trained taste panel. No differences in any of the sensory characteristics were observed between dietary groups. By blending VOs to provide balanced levels of dietary fatty acids, up to 100% of the fish oil could be replaced by the VO blend without compromising growth or flesh quality. At the same time, 75% of the dietary fish oil can be replaced without compromising flesh VLCn-3 PUFA content, thereby providing a beneficial nutritional profile for human consumption.

Torstensen, B.E. (bente.torstensen@nifes.no), Bell, J.G., Rosenlund, G., Henderson, R.J., Graff, I.E., Tocher, D.R., Lie, O., Sargent, J.R. (2005). Tailoring of Atlantic salmon (*Salmo salar* L.) flesh lipid composition and sensory quality by replacing fish oil with a vegetable oil blend. *Journal of Agricultural and Food Chemistry*, 53: 10166-10178.

27. Fish oil replacement with carbohydrate

This study examined the potential to reduce fish-oil use in feeds for Atlantic salmon, by substituting fish oil with graded amounts of carbohydrate, such that feeds with a low fat content had a high carbohydrate level and vice versa. These feeds were fed to S1 salmon smolts throughout their 377 day marine grow-out phase and growth performance, condition factor, yields and flesh quality attributes were documented. Fish grew from 53 to 2500 g and growth rate showed expected seasonal variation. Dietary lipid content did affect growth rates and final harvest weights, being lowest for fish fed the low oil (high carbohydrate) feeds. Dietary lipid content also affected fillet fat content, pigmentation and flesh colour. Therefore, in economic terms, the low oil feeds (high carbohydrate inclusion) would be of little use, but only growth and not flesh quality was compromised. Thus, there is still scope for the use of carbohydrate in Atlantic salmon feeds, but as a cost-effective means of substitution for lipids, their use is somewhat limited.

Young, A., Morris, P.C. (paul.morris@Nutreco.com), Huntingford, F.A., Sinnott, R. (2006). Replacing fish oil with pre-extruded carbohydrate in diets for Atlantic salmon, *Salmo salar*, during their entire marine grow-out phase: Effects on growth, composition and colour. *Aquaculture*, 253: 531-546.

28. Suitability of natural carotenoids

The desired pink to red colour of rainbow trout flesh can be obtained by adding carotenoids to the fish diet. This study was conducted to determine the effects on growth and colour retention of natural pigments (30 ppm red pepper meal, 60 ppm red pepper meal, 30 ppm shrimp by-products meal, 60 ppm shrimp by-products meal), synthetic carotenoids (30 ppm astaxanthin, 60 ppm astaxanthin), and a control group (no added pigment). Duplicates of each of the seven treatments were reared for 3 months. The best growth rates were obtained with 30 ppm astaxanthin and 60 ppm red pepper meal, and the lowest was in the control. The lowest food conversion ratio was obtained with 30 ppm astaxanthin and the highest was the control (2.23). Visual coloration values ranged from 14.46 in the 30 ppm astaxanthin group to 11.55 in the control. Retention coefficients ranged from 6.63 in the 30 ppm astaxanthin group to 1.79 in the 60 ppm shrimp by-products meal.

Diler, I. (idiler@yahoo.com), Hossu, B., Dilek, K., Emre, Y., Sevgili, H. (2005). Effects of natural and synthetic pigments in diets on flesh coloration and growth of rainbow trout (*Oncorhynchus mykiss* W.) *Israeli Journal of Aquaculture-Bamidgeh*, 57: 175-184.

29. Nitrogen-stunning of rainbow trout

This study examined the use of nitrogen gas for stunning rainbow trout. It was found that nitrogen was an effective stunning method and that the strong aversive reaction reported for carbon dioxide stunning was not observed. Nitrogen-stunning was then compared to percussive-stunning and air asphyxiation for effects on post mortem muscle biochemistry. Post mortem muscle ATP levels in nitrogen-stunned fish were significantly higher than for asphyxiated fish but lower than for percussively-stunned fish. This work indicates that the use of gasses other than carbon dioxide for stunning of fish deserves further study.

Wills, C.C., Zampacavallo, G., Poli, B.M., Proctor, M.R.M., Henehan, G.T.M. (gary.henehan@dit.ie) (2006). Nitrogen stunning of rainbow trout. *International Journal of Food Science and Technology*, 41: 395-398.

30. Salmon slaughter methods

In this study Atlantic salmon were slaughtered in three ways on a commercial slaughter line: (1) killed by a percussive stun after crowding; (2) killed by percussive stun after crowding, pumping and live chilling; (3) killed by exsanguination after crowding, pumping and live chilling. The live-chilled fish were exposed to seawater (2°C) saturated with carbon dioxide (pH 5.5-5.7) for 40 min. The fish were calm after live chilling, but not unconscious, as eye rolling was observed in all individuals. Subsequent exsanguination of the unstunned fish resulted in death. Both rapid live chilling and the subsequent exsanguination appeared stressful to the fish, as a large and rapid pH drop coupled with earlier onset of rigor mortis, indicative of high muscle activity during the process were observed. It was concluded that commercial use of live chilling in combination with high levels of CO_2 does not stun Atlantic salmon. Live chilling followed by exsanguination of the unstunned fish appears to be highly stressful and should be avoided.

Roth, B. (Bjorn.Roth@bio.uib.no), Slinde, E., Robb, D.H.F. (2006). Field evaluation of live chilling with CO_2 on stunning Atlantic salmon (*Salmo salar*) and the subsequent effect on quality. *Aquaculture Research*, 37: 799-804.

31. Effluent phosphorous

Excess phosphorus (P) in aquaculture feeds contributes to the eutrophication of natural waters. While commercially available low-P (LP) fish feeds have been developed, there is uncertainty about their potential to reduce effluent P while maintaining fish growth relative to regular P (RP) feeds. This study therefore fed rainbow trout for 55 days on either RP or LP feeds under simulated commercial aquaculture conditions, and determined effluent P levels, fish growth, and feed costs. Effluent faecal-P and soluble-P, but not particulate-P, were greater in RP than in LP raceways. Fish growth, bone-P and plasma-P were similar between diets, demonstrating that LP feeds can lower effluent P levels without compromising growth. However, costs were $0.97/kg fish production for LP feeds, and $0.74/kg for RP. Because feed is the largest variable cost in commercial aquaculture, the use of LP feeds can significantly increase production costs.

Sugiura, S.H., Marchant, D.D., Kelsey, K., Wiggins, T., Ferraris, R.P. (ferraris@umdnj.edu). (2006). Effluent profile of commercially used low-phosphorus fish feeds. *Environmental Pollution*, 140: 95-101.

32. Feeding melatonin delays smoltification

In order to examine the role of melatonin in the regulation of long-day-induced smoltification in salmonids, this study investigated the influence of photoperiod on plasma melatonin profiles and the effect of melatonin administration on masu salmon. Under light-dark (LD) cycles, plasma melatonin levels exhibited daily variation, with higher values during the dark than during the light. The duration of nocturnal elevation under short photoperiod (LD 8:16) was longer than that under long photoperiod (LD 16:8). Melatonin feeding (0.01, 0.1 and 1 mg/kg body weight) elevated plasma levels of melatonin in a dose-dependent manner for at least 7 h but not for 24 h. When masu salmon reared under short photoperiod were exposed to long photoperiod (LD 16:8) and fed melatonin (1 mg/kg body weight) 7 hours before the onset of darkness, a significantly smaller proportion of smolts appeared in the melatonin-fed group after 32 days than in the control group. However, after 59 days of the treatment, there was no difference in the proportion of smolts between the control and melatonin-treated groups. Thus, melatonin feeding mimicked the effects of short photoperiod, which delays but does not completely suppress smoltification. These results indicate that the day length is transduced into changes in the duration of nocturnal elevation in plasma melatonin levels, and that artificial modification of the plasma melatonin pattern possibly delays the physiological processes of smoltification induced by long-day photoperiodic treatment.

Iigo, M.(iigo@cc.utsunomiya-u.ac.jp), Ikuta, K., Kitamura, S., Tabata, M. & Aida, K. (2005). Effects of melatonin feeding on smoltification in masu salmon (*Oncorhynchus masou*). *Zoological Science*, 22: 1191-1196.

33. Discussion of genetic engineering in aquaculture

Within aquaculture, genetic engineering (GE) is emerging as a powerful method for breeding of fish and shellfish, and for developing alternative sources of feed and vaccines to

combat diseases. On the other hand, the use of GE in aquaculture raises ecological, ethical and economic concerns. For instance, genetically modified (GM) feed could be spread to the aquatic environment and consumed by other marine organisms, and horizontal gene transfer may conceivably occur from DNA in feed or vaccines to a recipient genome or by faeces to the environment. Numerous reports have described beneficial effects such as viral disease resistance following DNA vaccination. However, side effects, such as activation of other genes than those which are central in immune defence mechanisms, may occur and warrant further investigations. In order to achieve sustainable introduction of GE, it is crucial that appropriate scientific investigations are done and ethics are considered prior to large-scale introduction of GE products such as DNA/GE vaccines and GM feed in commercial fish farming. This may result in a solid basis for the avoidance of potentially undesirable health and environmental effects. If GE can help make aquaculture a sustainable industry, this opens the possibility of positive market and consumer responses. This can best be achieved by involving the stakeholders from the conceptual stage to the commercial stage by facilitating a transparent process whose purpose is to inform research, to identify decision stakes, and to influence design, adoption and implementation of pro-active policy.

Myhr, A.I. (annem@fagmed.uit.no), Dalmo, R.A. (2005). Introduction of genetic engineering in aquaculture: Ecological and ethical implications for science and governance. *Aquaculture*, 250: 542-554.

34. Effect of light intensity on trout feeding behaviour

The self-feeding behaviour of rainbow trout was studied under two different light intensities (50 and 700 lux) during the light phase of the light-dark cycle. Food wastage was also measured. At 50 lux, all groups of rainbow trout learned to operate the self-feeder within 4 days, whereas it took up to 25 days for all groups at 700 lux, suggesting that lower light intensities stimulate instrumental learning in rainbow trout. The total number of trigger actuations for the entire experimental period was higher at 50 lux than at 700 lux, although this may have been related to delayed learning at 700 lux. Growth rate was higher in fish at 50 rather than 700 lux, although this difference was non-significant. Light intensity had no effect on food wastage, and it did not appear to affect the proportion of trigger actuations during the light phase. Clear diurnal feeding rhythms were observed which were classified into four categories: uniform, dawn, dusk and crepuscular. At 50 lux fish generally fed at either dawn or dusk, whilst feeding was predominantly uniform during the light phase at 700 lux.

Noble, C. (chris@st.ntu.ac.jp), Mizusawa, K., Tabata, M. (2005). Does light intensity affect self-feeding and food wastage in group-held rainbow trout and white-spotted charr? *Journal of Fish Biology*, 66: 1387-1399.

35. Prion proteins in salmonids

This study reports the production and characterisation of antibodies to the prion protein (PrP) of rainbow trout, a piscine protein with characteristic structural features common to mammalian prion protein. The antibodies showed specificity for certain genera of the Salmonidae, binding to PrP of rainbow trout and Atlantic salmon but not to that from Arctic char. The study found that rainbow trout PrP is a 64 kDa protein present in the brain, spinal chord and optic nerve. PrP could be detected in all brain regions studied: optic lobe, cerebrum/olfactory lobe, cerebellum, hypothalamus/ pituitary and medulla oblongata. However, PrP was not detected in a range of peripheral tissues: eye, heart, stomach, intestine, liver, kidney, spleen, muscle and skin. These immunoreagents provide specific tools to study the biology of rainbow trout and Atlantic salmon PrP and any possible transmissible spongiform encephalopathy-like disease of these economically important fish species.

Maddison, B.C., Patel, S., James, R.F., Conlon, H.E., Oidtmann, B., Baier, M., Whitelam, G.C., Gough, K.C. (kcg3@le.ac.uk) (2005). Generation and characterisation of monoclonal antibodies to rainbow trout (*Oncorhynchus mykiss*) prion protein. *Journal of Immunological Methods*, 306: 202-210.

36. Certification issues in aquaculture

There is interest in certification of aquaculture production facilities in response to concerns about negative environmental and social impacts and food safety. This review identifies issues to be considered by stakeholders in developing certification standards for channel catfish, tilapias, rainbow trout, oysters, mussels, clams, scallops, abalone, and seaweed. Common issues include land and water use, water pollution, benthic effects, effects on biodiversity, use of

antibiotics and other chemicals, and relationships with workers and local communities. Specific, contentious issues apply to individual species or species groups. Fish meal use in feeds will be a major concern in finfish certification. Widespread use of therapeutic agents in trout culture will be a major concern. Use of groundwater, removal of daily mortalities, and medicated feed in channel catfish culture should be given particular attention. Tilapia culture can introduce these species into watersheds where they have not previously occurred, resulting in serious competition with native species. Some environmentalists and consumers object to hormone treatment of tilapia to produce all male fry. Discussions of shellfish certification should focus on water use conflicts and public health risks associated with the consumption of these organisms. The introduction of non-native species and genetic alterations with respect to oysters also will need to be addressed. Further introduction of non-native species should be a major topic in discussions of abalone and seaweed culture. The source of wild seaweed to use as food in abalone culture also will be an issue.

Boyd, C.E. (boydce1@auburn.edu), McNevin, A.A., Clay, J., Johnson, H.M. (2005). Certification issues for some common aquaculture species. *Reviews in Fisheries Science*, 13: 231-279.

37. Review of exotic farmed species

The culture of exotic fishes contributes about 17% to global food aquaculture production. Transplanted native species add substantially to the aquatic harvest of food and sport fishes in many countries. Some countries are very dependent on the cultivation of non-native species; yields of exotics exceed 25% of the total harvest in China, 60% of the freshwater harvest in the Philippines, and 50% of the production in Brazil. Aquatic food production in Israel is predominately from introduced fishes. In the USA, transplanted species are economically important as food and sport fish and exotics are used in resource management as well as a major food source. Countries of origin for globally important fishes include China (endemic carps), USA (Atlantic salmon and rainbow trout), Europe (common carp), and Africa (tilapias). The aquaculture production of food fish will become increasingly vital as oceanic capture fisheries continue to stagnate. Exotic and transplanted fishes that are widespread today will represent a greater proportion of future aquaculture production because technology for their culture is already well known and can readily be applied, and because these species are more easily domesticated and genetically improved.

Shelton, W.L. (wshelton@ou.edu), Rothbard, S. (2006). Exotic species in global aquaculture - a review. *Israeli Journal Of Aquaculture-Bamidgeh*, 58: 3-28.

38. Female trout are more laid back than males

It is becoming increasingly clear that individual differences in the behavioural response to stressful situations are associated with distinct physiological profiles, and stress coping characteristics are of fundamental importance to fitness and life history. Teleost fishes display considerable variation in reproductive strategy, but sex differences in stress-coping style have not been described previously in fish. Prior to sexual maturation, the physiological stress response is not affected by sex in salmonid fish. Nevertheless, behaviour in novel and stressful situations differed between immature male and female rainbow trout. When tested 1 week following transport to a new rearing facility, females resumed feeding after transfer to social isolation quicker than males. The locomotor response to acute confinement stress also varied between sexes, with females settling down and ceasing to move in a panic-like manner quicker than males. There was a strong correlation between behaviour in the two test situations: individuals that readily resumed feeding behaviour in a new environment also moved less in the acute stress test. Thus, the time to resume feeding after a stressful experience is a precise indicator of stress-coping style in salmonid fish, which is likely to reflect the dynamics of neuroendocrine stress responses. Furthermore, these observations could reflect a sex difference in the response to novel and stressful situations, which occur even in the absence of differences in glucocorticoid responsiveness.

Overli, O. (oyvind.overli@umb.no), Sorensen, C., Nilsson, G.E. (2006). Behavioral indicators of stress-coping style in rainbow trout: do males and females react differently to novelty? *Physiology & Behavior*, 87: 506-512.

Finfish in the Press

Perch may become farmed species

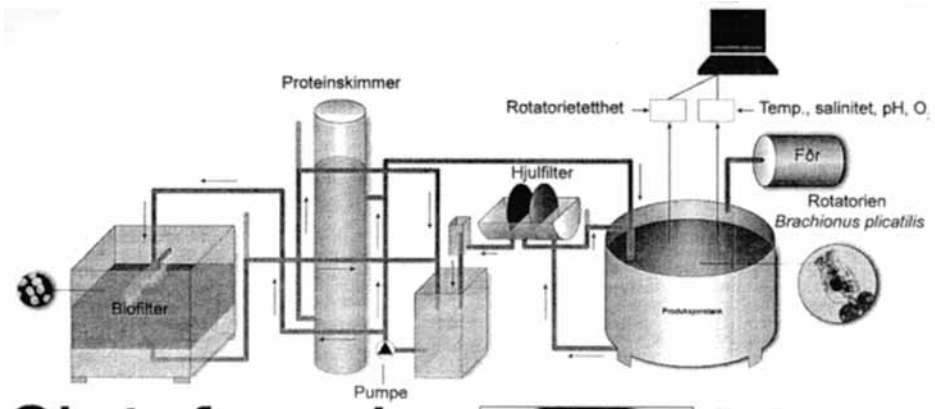
STUDIES from Denmark show that perch is well suited for being farmed. The researchers argue that farmed perch could complement traditional farmed species in Denmark such as rainbow trout and eel.

The Danish institute for Fisheries Research (DFU) has done research on perch and the study shows that the species could become a good alternative to the traditional Danish farmed fish industry.

"The perch has proved to be a robust and quick growing fish, which is not attacked by the most common virus diseases. The price of perch is attractive because it is a sought after food fish abroad, and it thrives in both fresh water and brackish water", project leader and biologist Helge Paulsen from DFU said in a statement.

The Danish researchers have had success in achieving better survival of newly hatched perch fry than has been the case abroad. They will therefore be able to keep the production price down and the researchers argue that there is potential for the export of settle fish – fish ready for farming - abroad.

Fish Farming Today, December 2005



Sintef works on dry diet

Plan of Sintef's novel recirculation system for rotifer production

Left: Dr José Rainuzzo: 'we can have good results within two years'

WORLD-RENOWNED Norwegian research body Sintef is developing a new dry feed to replace live larval feeds, reports **BERNADETTE TOURNAY**.

"There is a huge step that needs to be made in marine aquaculture – to produce a dry larval feed that can be used from day zero," says senior scientist Dr José Rainuzzo.

"If this is done production costs in hatcheries will be considerably reduced."

Sintef began work four years ago by seeking new sources of polyunsaturated fatty acids for use in larval feed and enrichment diets.

Researchers have found that, as feed particles need to be very small and contain all the nutritional components required, raw materials must contain high levels of essential fatty acids.

Interest has focused on single-celled, marine microorganisms such as those of the Thaustrocytrid family, as well as different marine microalgae, as possible new sources of fatty acids.

Marine bacteria are also being considered as possible sources of polyunsaturated fatty acids (PUFAs) but to date there have been only low yields, and more research is required.

In Sintef's work, different wild strains of micro organisms were collected. Those that grew well in the laboratory and had high essential fatty acid content were selected.

Although the process is still being optimised, researchers can already produce 50g a litre dryweight using fermentation technology.

"We are doing trials with extracted oil in the form of an emulsion for live feed enrichment from a strain of Thaustrochytrids, collected in Norwegian waters, and from the by-product which is rich in phospholipids and has 18% total lipid content – nearly 100% phospholipids," explains Dr Rainuzzo.

"The oil and by-product, which also contains protein and carbohydrates, are very rich in DHA."

He adds that the 50g/l could still be improved, resulting in the potential for a commercial product, but this would need development by a commercial company. More industrial-scale research would still be required on the processing technology, but once carried out a product could be on the market in a relatively short time.

"I think we can have good results within two years," says Dr Rainuzzo. "I am not sure we could manage to fully replace the use of live feed for cod, but I am sure that at least we will reduce costs.

"Once this is achieved there will be more cost effective production and more marine species could be produced.

"Even though many marine species have their own nutritional requirements, the big step is to produce a larval feed which can be produced commercially in significant amounts."

Sintef has also developed a new recirculation technique to produce large volumes of rotifers. This was motivated by the need for microalgae and zooplankton as live feed for species such as cod and halibut.

"Producing cod and halibut requires large quantities of rotifers, so we have developed a marine greenhouse that cultivates plankton with the aid of recirculation technology," says Dr Rainuzzo.

The greenhouse system comprises a 3000-litre production tank with an automatic cleaning arm at the bottom, a feeding system for rotifers, external filter, foam fractionator and biofilter. The whole volume of water is recirculated three times in 24 hours.

Sintef's system can produce 1.25 billion rotifers a day, but Dr Rainuzzo says this can be bettered by increasing rotifer density. The system has been tested successfully at Fosen Aquasenter cod hatchery, not far from Sintef's new R&D facility in Trondheim., but more work is required before a commercial prototype is produced.

Fish Farming International, December 2005

Ewos unveils artemia replacement

A NEW live-feed replacement for marine fish is being introduced by feed giant Ewos.

Ewos Promarin is the result of over a decade of research between Ewos Innovation, the Norwegian Institute of Fisheries and Aquaculture Research and Feedback Aquaculture of Risor, Norway.

It has been tested as an artemia replacement feed on a series of warm water fish at sites in Portugal and Malta. Additional testing in Norway with farmed cod has also proved to be highly successful, according to Ewos.

"Promarin has been tried with seabass, seabream, turbot and sole – all with very good results," says Ragni MacQueen Leifson of Feedback Aquaculture who helped to develop the feed. "It should also work with shrimp, in fact with any species that needs rotifers and artemia."

Ewos says that Promarin uses the "natural technical properties of phospholipids." These are fat derivatives in which one fatty acid has been replaced by a phosphate group and one of several nitrogen-containing molecules.

Phospholipids are a major component of all biological membranes and are used to form biomembranes within the Promarin particles. These biomembranes combine the ability to retain water-soluble nutrients while controlling their leakage to balance feed attractiveness with nutritional composition, according to Ewos.

Although when looked at solely at a fish-per-fish cost analysis between fish raised with Promarin and those with live feed the costs would be similar, there are advantages to using Promarin, according to Leifson.

"You can take it right out of the refrigerator to use so there is no manpower being wasted on growing rotifers and artemia and the expenses that goes with raising them," she says.

"In addition, every time you introduce something live into a tank of fry you run the risk of introducing bacteria."

In addition, the nutritional value of artemia varies among various geographical strains and with its stage of development. Because of this, and a need to increase the amount of highly unsaturated fatty acids such as EPA and DHA, artemia is often times enriched. However, by using an artemia replacement feed which has a consistent, measurable nutritional level, this should never be a factor.

Weaning with Promarin should start when the larvae reach a dry weight of 200 microgrammes (wet weight 1.2mg). From the start of weaning the daily amount of rotifers should remain fixed at the level used on the first day of weaning. To get the most from Promarin, Ewos recommends that rotifers be added two or three times a day, with Promarin introduced at regular intervals (ie, every few minutes using an automatic feeder). When larvae reach 300 microgrammes (wet weight 1.8mg), rotifer numbers should be gradually reduced until the fish are completely weaned onto Promarin.

According to James Deverill of Ewos, although Promarin is designed to be a complete artemia replacement feed, it's been found beneficial to introduce low levels of unenriched artemia (no more than 10kg of artemia per million juveniles) into the tanks.

"The movement of artemia seems to trigger a feeding response in fry and increase the consumption of Promarin," he says. "Once they start feeding, they no longer seem to need this trigger."

Promarin will be exhibited at both Aqua 2006 in Italy and Aquaculture International 2006 in Scotland.

Fish Farming International, December 2005

Cod can tolerate temperature drop

TESTS conducted at Fiskeriforskning in Norway show that farmed cod ready to be transferred to sea cages tolerate drop in water temperature well – although growth is temporarily affected.

In intensive farming, fish fry are hatched in land-based tanks where they remain until they have grown enough to be transferred into cages in the sea.

This production is costly so it is common to increase the water temperature in the tanks to help the fish grow faster and therefore be transferred earlier to sea cages. The transition from land to sea may involve a large drop in temperature, especially during winter months.

Cod farming is an industry in its early stages and it is important to acquire as much knowledge about cod in aquaculture in order to achieve a stable and season-independent production. Therefore, Fiskeriforskning has studied how cod tolerate these temperature changes and what role, if any, the size of the fish plays.

In the tests, different groups of fry were acclimatized to water temperatures of 8 to 15°C for a month prior to being transferred to cold water at 1 and 3°C, respectively.

One day after the transfer, fish from the different water temperatures were compared, looking at body fluid balance and various signs of stress. The tests also evaluated how fish of different sizes tolerated the drop in temperature, as well as the long-term consequences of transfers from warm to cold water.

The results show that the cod tolerates the transition from warm to cold water quite well, and that size is not important as long as the weight exceeds 25g. For a period after the transition, the growth is temporarily impaired in fish that are used to higher temperature compared to fish used to lower temperatures.

The weight difference in fish from the various acclimatisation temperatures disappeared after 4 to 8 weeks at low temperature.

According to the Norwegian research team, the temperature the fish was put into seems to have more significance than the temperature of the water it came from. While cod that were transferred to 3°C water did well, those that went into 1°C water had more problems, particularly fish that were used to 12°C or higher.

"One should therefore avoid transferring fish to such low temperatures, or adapt the water in the tanks such that the fish is grown at lower temperatures in periods when the sea water is at its coldest", said scientist Bjørn-Steinar Sæther.

There have been speculations about using cooling water from a natural gas plant at Melkøya could be used for aquaculture purposes, since the warmer water has favorable growth effects on fish before they are transferred to sea cages.

"The tests show that a large drop in temperature temporarily impairs growth. It will be necessary to assess the growth benefit from using heated water before the transfer to sea cages if it means the fish must move directly from high to low temperature," said Sæther. "An alternative can be to gradually acclimate the fish to the sea temperature before moving it to a cage."

Fish Farming International, December 2005

Iceland – a serious fish farming contender

ALTHOUGH Iceland is a minor player in aquaculture compared to its Nordic neighbour - Norway, new developments and research could see it become a serious fish farming contender in the future.

Fisheries companies have finally discovered that Iceland, with its clean, fresh and virtually disease free water, as well as economical geothermal water for heating, is a place worth investing. It is also the only country in Europe to be A-graded nationwide according to EU regulation.

Aquaculture has been a small scale industry in Iceland since the 1980s, but investments have been limited. However, currently money is being put into salmon and trout farming, as well as research into cod farming. It is expected that production will expand greatly over the next years. In 2003, Iceland produced 3.5 million tons compared with 1.8 million tonnes in 2002. The ministry of Fisheries forecasts that in 2012 the export value of aquaculture will be ISK 36,000 million, up from ISK 1,400 million in 2003.

Farmed salmon production is currently the largest aquaculture export from Iceland and has scarcely increased. In 2002 Iceland produced around 1,1 million tons, worth ISK 671 million. Global production was, however, more than 1 million tons, of which Norway produced 430,000 tons.

Atlantic salmon eggs are also available from Iceland all year round for the world market. The eggs have been obtained by selective breeding of the stock, and are in great demand with aquaculture companies in Ireland and South America

The second largest Icelandic farming export for the year 2002 was farmed trout with 583 thousand tons, which amounted to ISK 330 million. Other farming exports including turbot and halibut were limited with around 115 thousand tons, worth ISK 191 million.

Salmon and trout is exported fresh or frozen and either whole (gutted) or as fillets. A considerable quantity of smoked salmon fillets is also exported. Modern transport and logistics make it possible to export fresh whole fish and fresh fillets by air from Iceland to all the major fresh fish markets. The customers are the retail sector and food service operators in Europe and North America who appreciate a steady supply of good quality fresh fish.

Experiments with mussels and rearing spotted wolf fish have started and they could become export items in the future.

Icceland has also achieved great success in hatching, smolt and fingerling production and rearing of difficult species such as halibut. In the mid-90´s, Norway had 20 halibut fry farms (now there are about six left), which struggled to produce halibut of good enough quality. Ironically, one Icelandic company was behind approximately half of the world production. Still today, Iceland´s production of halibut fry is considered to be the most advanced by people in the industry. Historically, Iceland's main livelihood has always been fisheries and by keeping up-to-date with both new technology and consumer demands in the international marketplace, the fish farming industry will continue to make an attractive proposition for investors and could develop to become an even stronger and more important sector.

Fish Farming Today, December 2005

Lincolnshire farmer's son sets up first turbot farm in England

A LINCOLNSHIRE farmer's son has set up the first turbot fish farming business in England with the help of a grant from Defra's Rural Enterprise Scheme (RES). Jonathan Stow of Grayingham, near Gainsborough, has always been keen on fishing and after gaining specialist qualifications in Scotland and practical experience in the fish farming industry he decided it was time that the family holding diversified.

This summer he travelled to France to collect and place 6,500 juvenile turbot into his newly installed re-circulation system in a temperature controlled building on the five acre holding. By January the fish should have grown from 5g to between 500g and 1kg and will be ready for sale to restaurants and fishmongers throughout the UK. The farm plans to produce up to 25,000 fish per annum.

"Turbot farming is a relatively new industry in the UK as it is quite technologically advanced and fish farmers have so far specialised in traditional British favourites such as trout, salmon or oysters," Jonathan said.

"But British consumers are getting more adventurous nowadays - particularly in restaurants - and like to try fish they have eaten on Mediterranean holidays or seen on TV cookery programmes.

"Turbot is a large flat fish with white flesh and a subtle refined flavour. You don't need to add fancy sauces - it's great steamed, baked, fried or grilled with a few simple ingredients. I'm sure once people try it they will want to eat it again and again."

The next stage in the Stows' project will be to market their turbot to restaurants and consumers who previously would have bought sea-caught fish, which tends to be seasonal and therefore expensive. One very promising area of sales could be specialist Chinese supermarkets and restaurants. Turbot is very popular in Chinese and other far eastern cookery.

The Chinese chefs prefer to buy their fish live - so the opportunity of buying straight from an English fish farm should be welcomed by many oriental restaurants and caterers. Once fully operational the Stow's fish farm will be able to produce 25 tonnes of fish annually and will have the potential to supply customers throughout the year. Robert Powell, an adviser for the Rural Development Service in the East Midlands said: "This is an exciting RES project as it is not only bringing a new industry to rural Lincolnshire but is demonstrating how science and commerce can come together to benefit a rural business.

"The Stows are now providing full-time employment for three people at the fish farm and there is potential for further growth. I look forward to seeing Lincolnshire turbot on the menu in as many restaurants as possible in the future."

Fish Farming Today, December 2005

BMFA holds 17th annual workshop in Oban

THE British Marine Finfish Association (BMFA) held its AGM & 17th annual workshop in Oban at the end of October.

BMFA Chairman Alastair Barge welcomed 65 delegates to the workshop, which opened with an overview of the marine finfish industry.

The first session began with a presentation by Richard Slaski of the FSAP on UK and Norwegian production of halibut and cod. He was followed by Martin Wilhelm of Prokaria, Iceland who discussed cod and halibut production in Iceland. Didier Lecler, of ACUI-T, France gave a presentation on Chinese aquaculture and, in particular, the production of marine fin fish. Patrick White of AKVAPLAN- NIVA followed with a presentation entitled "Sea bream and sea bass production in the Mediterranean".

The second session focused on technical developments and featured six presentations:

"Larval Gut Microflora" by Professor Harry Birkbeck, University of Glasgow; "Vibrio Vaccination trials" by Dr Ian Bricknell, FRS Marine Lab., Aberdeen; "Biosecurity in Marine Fin Fish Hatcheries" by Dr Pauline Munro, FRS Marine Lab; "Broodstock Nutrition" by Dr Gordon Bell, Institute of Aquaculture; "The Genetics of Cod" by Marine Herlin, Institute of Aquaculture; and "Effects of fish meal replacement with full fat soya meal on growth and tissue fatty acid composition in Atlantic cod" by Vasileios Karalazos, Institute of Aquaculture.

In the afternoon, a session on customer satisfaction featured: "A comparison of flesh quality in farmed and wild cod" by Dr Lesley McEvoy, Johnson Seafarms Ltd., (co-authors: John McEvoy, Justin Watson, Ralph Bickerdyke, Joanne Good, Nick Bradbury);

"A Survey on consumer attitudes" by Julie Graham, Market Insight Executive, Seafish;

"The NorthCod Project" by Dr O. Ottesen and A. Karlsen, Bodoe College University, Norway; and "The Organic Food Federation Certification Scheme" by Julian Wade, executive secretary and Richard Bosly, technical manager, The Organic Food Federation.

The workshop concluded with a presentation on integrated aquaculture systems. Dr Maeve Kelly of the Scottish Association for Marine Science, Dunstaffnage, gave a presentation entitled 'Let's Integrate to Accumulate! - Utilising 'waste' in open water aquaculture" (co-authors: Craig Sanderson, Liz Cook and Andrew Rodger).

The workshop concluded with a summary from the chairman and general discussion.

The workshop was sponsored by Skretting, Dana Feed, BioMar, and Ewos and the BMFA's programme is assisted by Highland Council.

Pictured are speakers at the BMFA workshop. From left to right: Richard Slaski, Didier Leclecq, Marine Herlin, Ian Bricknell, Julie Graham, Martin Wilhelm (at back), Lesley McEvoy, Julian Wade, Maeve Kelly, Richard Bosly, Pauline Munro, Alastair Barge, Harry Birkbecks and Patrick White.

Fish Farming Today, January/February 2006

New strategy marks start of planning system to protect Scotland's water

A NEW era in policy and practice for Scotland's water environment began in December when environmental watchdog, the Scottish Environment Protection Agency (SEPA) launched the River Basin Planning Strategy for the Scotland River Basin District.

Representing the start of the implementation of river basin planning for Scotland, the Strategy is a requirement of new legislation to protect and improve all of Scotland's waters.

SEPA's Callum Sinclair said: "At the heart of the Strategy lies SEPA's vision of river basin planning as a system that will promote sustainable water use in a manner that protects and improves the water environment. The active involvement of other interested parties will be crucial to the success of the Strategy and the new planning system. The Strategy will help inform organisations and communities on how and when they can become involved in river basin planning in the future, and to consider how their contributions will be most effective. For some, this process has already begun by attending seminars held in 2003 or by responding to the formal public consultation exercise in 2004."

The actions in the strategy focus on three strategic areas and have been developed using the views expressed in the participative and consultative exercises:

1. Establishing administrative arrangements and working principles to support the production of river basin management plans;
2. Delivering participative and consultative opportunities; and
3. Integrating and co-ordinating river basin plans with other plans and planning.

Mr Sinclair added: "River basin planning and the River Basin Management Plan it will produce will deliver a range of short, medium and long-term benefits for Scotland's water environment. This Strategy will form the basis on which SEPA and its partners can plan and prepare to deliver basin planning in order to better protect, manage and improve Scotland's waters for everyone."

The Strategy also outlines SEPA's commitment to establish a National Advisory Group and a network of eight Area Advisory Groups in 2006.

The River Basin Planning Strategy for the Scotland River Basin District and a digest of responses to the 2004 public consultation are now available at www.sepa.org.uk/wfd/rbmp.

To receive a copy of the Strategy, e-mail publications@sepa.org.uk.

New legislation will protect and improve Scotland's waters.

Fish Farming Today, January/February 2006

Farmed cod keeps flavour for longer than wild cod says research

A RECENT report from the Icelandic Fisheries Laboratory, on "Shelf life, texture, muscle structure and processing of farmed cod" shows that farmed cod keeps its characteristic flavour for a longer period although the total shelf life was similar, interseafood.com reported. The report is the continuation of the report "Quality analysis on farmed cod" published in 2004.

The aim of the project was to study the harvest quality of farmed cod (Gadus morhua) and compare it to wild cod.

On the other hand, the results of last year's project were that the quality of wild-farmed cod increases with prolonged farming period. The quality of fillets of wild farmed cod that was on-grown in sea-pens for 19 months was higher than that of cod after the traditional 6-7 months of farming. Furthermore, farmed cod presented a much lower water holding capacity than wild cod. However, water holding capacity had greatly increased when the feeding ration was reduced for the last seven weeks of farming.

Farmed cod keeps flavour for longer.

The gaping is connected to pH of the muscle and the amount of feed given. When ration is decreased the pH increases and less gaping is seen. Sensory analysis showed significant difference, where cultured cod was found stiffer, dryer and tougher than wild cod. Image analysis on farmed cod muscle showed a lot of fluid (water) collection between the muscle cells (outside the cells). This phenomena has not been seen in wild cod. The new report, which is an extension of last year's report, compares among other things the shelf life of farmed and wild cod. The main emphasis of the study was on shelf life, texture characteristics and processing properties of cod fillets in order to explain the reason why farmed cod muscles showed an increased water collection between the muscle cells.

Fish Farming Today, January/February 2006

New cod disease found in Norway

THE Norwegian Veterinary Institute has found a new disease in Norwegian cod, the Norwegian Food Safety Authority has reported. A bacterium identified as Francisella sp. has been isolated in connection with an outbreak of disease where the main characteristics have been chronic inflammation reactions with knots in several organs. Some fish reportedly had eye injuries and a few had bloody knots in the skin.

In one farm, 40 percent mortality was registered in adult cod over a period of five months. For the time being it is not clear how widespread the disease is, or whether it affects wild fish.

The isolated bacterium does not grow at 37 degrees, and it is unlikely that the disease can be transferred to warm-blooded animals. A similar bacterium has been found in connection with disease in tilapia in Taiwan and in marine fish in Japan, the authority writes.

The Norwegian Food Safety Authority urges the fish farming industry to be extra vigilant with regards to this disease and to report any suspicions to the fish health service.

Norwegian cod farmers have been urged to be extra vigilant.

Fish Farmer, January/February 2006

Expert panel reviews fish farm rents

AN independent panel of experts put fish farm rents under the spotlight last month at the first meeting of a group brought together by The Crown Estate and aquaculture industry representatives.

The group, which includes former Marine Harvest Scotland boss David Windmill, Stephen Pollock, Head of Valuation at chartered surveyors James Barr and Alan Christie of Ernst and Young, aims to find a better way of charging fish and shellfish farmers in the UK.

As Frank Parrish, The Crown Estate's Marine Estate Director explained: "Fish farming is an industry of great importance to the rural areas of Scotland and we are keen to make sure that our rents better reflect the needs of the modern day fish farmer. Aquaculture has changed significantly over the years and we hope the expert panel will find a simple and understandable method for charging.

"We have worked with the industry to select an impressive group of people at the top of their field. Over the coming months they will be looking at past and current economics and prospects for the future in order to develop alternative charging systems. I am confident they will produce a solution which better meets modern needs.

Alan Balfour, of Loch Duart Ltd, commented: "The selection of this independent panel of experts is an encouraging start to this important process for the salmon farming industry. Given the challenges the industry faces, it is also reassuring that The Crown Estate is guaranteeing there will be no increase in rentals for individual farmers for three years, no matter what the outcome of the review."

The Crown Estate owns the seabed out to the 12 nautical mile limit and charges fish and shellfish farmers who want to moor their cages, long lines or other equipment in the UK's coastal waters, just as landowners charge farmers rent for the use of their fields.

But the current system for charging salmon farmers, based on future projections of production levels, is complex and hard-to-follow. So, with widespread industry support, earlier this year The Crown Estate initiated a review of the way it charges fish and shellfish farmers around the UK coastline.

Fish Farmer, January/February 2006

Immunity boosted by cod milt protein

COD'S MILT - the spermatozoa and seminal fluid from fish - can help strengthen a farmed fish's immune system against disease, research work in Norway has found.

The mitt of cod is rich in histone proteins, and it is these that have proved beneficial to farmed fish.

Norwegian R&D institute Fiskeriforskning reports on the recent work by Gum Meldre Pedersen, who in her doctoral work studied to what extent these proteins can be used in feed or vaccines to stimulate the immune system and therefore increase disease resistance.

In tests, the histone proteins were added to salmon cells and in food for cod.

"The histories activated the salmon's white blood cells and triggered mechanisms that protect against bacteria and viruses," Pedersen said in Fiskeriforskning's latest Info newsletter.

"In the cod, the histone supplement made it better able to resist bacterial infection."

Milt is one of many raw materials normally leftover following processing and slaughtering operations, so its potential as a beneficial additive will come as welcome news to the industry.

Dr Pedersen's work was part of Fiskeriforskning's strategic institute programme, 'Increased Value Added Through Better Utilisation of By-Products and By-Catches', financed by the Research Council of Norway. ■ www.fiskeriforskning.no

Fish Farming International, February 2006

Large-scale tilapia farming in Belgium

A NEW Belgian aquaculture company is aiming to have the largest European tilapia farm and processing centre up and running by the end of the year, with an annual capacity of up to 3000 tonnes.

Vitafish's farm is being developed at Dottignies industrial park near Mouscron, on the border between Kortrijk in Belgium and Lille in France. Around 30 new jobs will be created at the farm.

Because of the cold Belgian climate, the company says it will use a closed recirculation system, guaranteeing 100% traceability in combination with the vertically integrated production process. The only external aspect is the food, which will undergo strict controls.

The closed recirculation system will recycle more than 95% of the water used on the farm, which Vitafish says represents major energy savings. Large state-of-the-art biofilters should ensure optimum quality of recycled water. Farm waste will be earmarked for fertiliser and biofuel, while processing plant wastes will be turned into a wide range of secondary products in the future.

Joost De Smedt and Sophie Jonckheere of Vitafish guarantee that heating costs will not be critical in the venture. Through modern energy recuperation and production systems, the heating costs should be negligible compared to feed costs, they claim.

Broodstock that is being reared in the cellars of an office block in the neighbourhood of Aalst (30km from Brussels) are earmarked to be at the farm hatchery by April, with the first 300 tonnes of market size fish expected by September.

The choice of Mouscron for the farm was based on the town's central location between major cities (Brussels and Lille) with easy access to Boulogne and London. Good connections to European markets and an eco-inspired corporate culture guarantee product freshness (fresh filet, gutted fish). VitaFish is confident of fulfilling the highest quality standards (HACCP, BRC, IFS, ISO 22000) from the first day of production.

It is a search for economic feasibility that dictated the size of the factory for investors. According to De Smedt, many aquaculture ventures fail because they start off on too small a scale and therefore never get economically viable.

The farm will cost €15 million. Private money accounts for 50% of the project capital. Besides De Smedt and Jonckheere, investors include Luxembourg investment fund C+ Investments, Société Régionale d'Investissement de Wallonie and HoccInvest, along with other private backers. The project has also been granted subsidies from Walloon and European authorities.

The interest already taken by supermarket chains is said to be large.

■ sophie.jonckheere @vitafish.com

Fish Farming International, February 2006

US 'super-sizes' rainbow trout

NEW genes that may regulate growth in rainbow trout have been discovered by US Department of Agriculture ARS (Agriculture Research Service) scientists. By manipulating these genes additional muscle mass – not fat – would grow in the trout, producing a larger, meatier fish.

Molecular biologists Scott Gahr and Caird Rexroad, of the National Center for Cool and Cold Water Aquaculture in Leetown, West Virginia, are comparing genes known to be responsible for growth and development in mammals with similar genes in rainbow trout.

Initial efforts focused on the Inhibitor of DNA Binding/Differentiation (ID) genes. The ID genes interact with factors present in muscle cells to delay differentiation (the process by which cell function is defined) and increase the number of cells. "Affecting the balance of these processes presents an opportunity to dictate an increase in the number of muscle cells, which would result in more edible flesh on the fish," says Gahr.

Gahr and Rexroad identified four new rainbow trout ID genes and further characterised two previously identified genes. ID1A and ID2A were identified from previously published data. Using a combination of genomic approaches, they were able to identify three more ID1 genes (ID1B, ID1C, and ID1D) and one other ID2 gene (ID2B).

The ID1 genes have similar protein structures and were observed to be expressed in a variety of tissues. Expression of ID1B and ID1C increased during the middle phase of embryonic development, concurrent with muscle cell differentiation. This suggests that these genes may be important for muscle growth and development.

"One of our goals is to improve growth characteristics for the rainbow trout farmer through genetic selection, and these genes are clearly involved in muscle growth and development," says Rexroad.

Tests were developed and conducted for each of the rainbow trout ID genes to determine tissue distribution and embryonic expression. "It's important to know where the genes are expressed to be able to begin to clarify their roles in the fish," says Rexroad. "This illustrates the intertwining of two areas of research interest – physiology and genomics – and the importance of understanding the relationships between them within the organism."

ID gene DNA and mRNA sequences have been entered into the GenBank system, and expression patterns of the genes in different tissues and time points during embryonic development were published in May 2005.

"To facilitate progress in this research area, information on genes must be made available to any scientist interested in doing work that will help the rainbow trout industry," says Rexroad.

This research is part of Aquaculture (#106), an ARS National Program described at www.nps.ars.usda.gov.

Fish Farming International, February 2006

Bactericide proves successful on cod and haddock ova

PYCEZE – bronopol – which is authorised in the UK and elsewhere as a treatment and control of fungal infections (*Saprolegnia* spp) in fertilised salmonid eggs, has proven effective on cod and haddock ova in recent trials carried out at the Ardtoe research station on the west coast of Scotland.

The egg surfaces of fish are highly favourable substrates for bacterial growth when eggs are held in densities typical of marine hatcheries. This affects survival of the egg to hatch and also creates a route for pathogen transfer to larvae and between larval rearing units.

Good hygiene is required in hatcheries to ensure adequate hatching and larval survival rates.

Pyceze (bronopol) used as a treatment and control of fungal infections in fertilised salmonid eggs, as well as for the control of fungal infections in farmed Atlantic salmon (Novartis Animal Vaccines).

Researchers at Ardtoe Marine Laboratory used Pyceze as a disinfectant on marine finfish eggs, as bronopol is also an efficient bactericide.

Cod eggs were treated by contact immersion for 45 seconds just after collection (and haddock eggs for 60 seconds) and before stocking in egg rearing units, also by direct infusion to the rearing units by pump, and by treating the eggs in situ in the rearing units by turning water flow off for 30 minutes and dosing with 50mg per litre bronopol.

Three concentrations of Pyceze were compared with traditional Kickstart treatments. Although it is safe to use higher concentrations of Pyceze and longer exposure (at least five times the dose, and for twice the treatment period) 50mg/l active gave significant reductions in bacterial numbers, 30 bacterial colony forming units CFUs per ml of fish eggs compared with 14,000 CFUs in non-treated eggs.

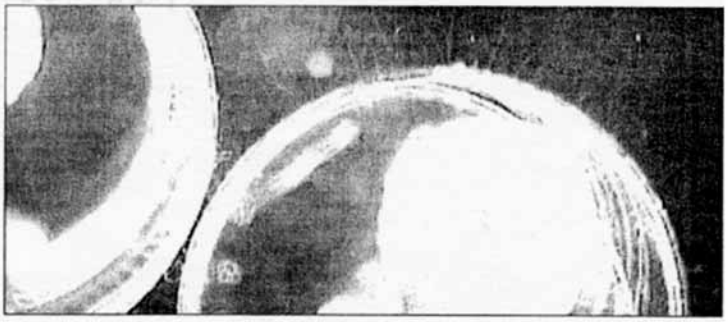
Eggs treated with Pyceze showed a smooth clean appearance compared with untreated eggs displaying a growth of filamentous bacteria (see Photo treated and untreated eggs).

However, a procedure likely to give less disturbance to the eggs and a longer exposure time was to disinfected the eggs directly in the incubation unit with 50mg/l active bronopol (=100mg/l Pyceze).

The water supply was discontinued for 30 minutes, aeration provided to enable Pyceze to mix and to keep the eggs in suspension.

This procedure is recommended on stocking the incubators and just prior to egg transfer to larval rearing units.

■ **Details can be found in the October issue of *Aquaculture* at Treasurer J, Cochrane E, Grant A (2005).**



A haddock egg from continuous disinfection with 50mg/l bronopol showing a smooth 'clean' chorion surface on the left, compared with a non-disinfected egg with filamentous bacterial growth on the right

Fish Farming International, February 2006

EU moves on organic rules

THE EUROPEAN Commission has taken its first significant step on the road to producing a unified definition of organic foods – something both producers and consumers have been clamouring for increasingly in recent times.

However, according to a proposed regulation imposing rules on aquaculture businesses seeking to market organic fish, the Commission explicitly suggests: "polyploidy animals may not be used".

Some in the industry see this as preventing salmon – a polyploid – from being marketed as organic within the EU, even if its feed is sustainable and welfare standards are high.

However, the regulation is a proposal, and as such will not come into effect without much consultation between all parties that it can potentially affect.

Polyploid organisms have more than two copies of their chromosomes and so can evolve generation to generation, a key worry for organic consumers seeking genetic purity in their foodstuffs.

Most polyploids are plants (eg, wheat), but salmon is a notable exception. Other organic production rules the Commission wants imposed across the EU include that "feed used in aquaculture shall be from sustainable fisheries or composed essentially of agricultural ingredients from organic farming and of natural non-agricultural substances".

And it suggests a broader principle: "Aquaculture production shall minimise the negative effect on the environment."

Should the regulation be approved by the EU Council of Ministers and the European Parliament, the Commission would be authorised to draft more detailed production rules for organic aquaculture products.

Meanwhile, national governments could use their own organic production standards, and would have to recognise those in other member states.

■ **http://europa.eu.int/eur-lex/**

Fish Farming International, February 2006

Alltech seminar promotes growth

PROMISING results from trials using replacement minerals in the diet of trout on a Bulgarian fish farm were among the highlights of the recent one-day seminar organised by biotechnology company Alltech at its European headquarters near Dublin in Ireland, reports **KENNY McCAFFREY**.

Attended by more than 50 experts and representatives of major industry companies and research institutes from 17 countries, this third annual European Aquaculture meeting discussed, among many topics, organic mineral nutrition, gut health status and morphology and new molecular tools to investigate gene expression and nutrition.

Dr Yordan Staykov of Trakia University in Bulgaria gave encouraging results from trials with Bioplexes and Sel-Plex – both Alltech products – on the performance and immune status of rainbow trout fingerlings.

The trials, which took place at the Navicom farm in Bulgaria, showed that the Alltech products did have a beneficial effect on the trout. This year the farm hopes to test the products on farmed sturgeon, Dr Staykov revealed.

There were many other interesting talks. Prof Giovanni Bernadini, of the University of Uninsurbia, Italy, addressed the use of molecular tools to investigate welfare, growth and performance in seabass and other species of commercial interest.

He described the identification of more than 1400 genes in seabass and through gene expression related these to stress and environmental conditions.

Dr Simon Davies, of the University of Plymouth, UK, spoke on 'Gastrointestinal Morphology in Cultured Fish and the Effect of Bio-Mos on Gut Integrity: New Perspectives".

He explained the role of gut function, prebiotics and mannan oligosacharides, which beneficially affect the host by selectively stimulating improved gut morphology and function and altering microbiota.

Dr Turid Morkore of the Nutrition Group, Akvaforsk in Norway, discussed 'Dietary Impact on Fish Quality of Farmed Atlantic Salmon'. She reported that early trial results with Alltech's Salmon Pak, which includes Bio-Mos and Bioplex, reduced significantly the gaping losses, which were responsible for 38% of salmon fillet rejection at processing.

Alltech's European technical manager, John Sweetman, said he was pleased with meeting. "Alltech has a clear vision on how they can contribute to this industry with their products in order to ensure a better performance and thus higher profits for the aquaculture industry players," he said.

Timm Neelsen, Alltech's European aquaculture coordinator, added: "Products such as Bio-Mos and Bioplex have shown great results in the diets of aquaculture and explained the importance of numerous independent trials."

■ Alltech is this month embarking on its 20th European, Middle East and African Lecture Tour, under the banner 'Future Growth Promotion' and focusing on mycotoxins. The tour takes in around 40 venues in almost as many countries, from Ireland to Albania, Finland to Egypt.

Fish Farming International, February 2006

Shetland organic cod set for UK launch

By Christina Reid
Senior Reporter

ORGANIC cod fillets from fish farmed in Shetland are set to be launched throughout the UK. Announcing the launch of its 'No Catch...just cod' brand, Shetland-based Johnson Seafarms said it is the world's first truly sustainable organic cod farm.

Chairman of Johnson Seafarms, Laurent Viguié said: "No Catch is the future of fish. We offer a superior quality cod with firm white flakes and unbeatable taste, which has been reared in a highly sophisticated, pristine, environmentally sensitive, sustainable environment.

"No Catch is always fresh with no additives and is never frozen... it's just 100% organic, sustainable cod. We're immensely proud to introduce such a unique product to the UK".

Family owned Johnson Seafarms, along with its predecessor companies, has had a 20-year history in salmon farming. During the recent crisis then owners Ivor and Angus Johnson began experimenting with farmed cod.

The business was bought by management in March 2005 when the team headed by Mr Viguié managed to secure a £21 million investment deal with the London City. Since then, the company has heavily invested in cod farming, adding several new sites as well as a cod hatchery to its portfolio.

A newly equipped fish processing plant in Scalloway is at present recruiting workers.

Unlike wild cod caught at sea, No Catch cod is packaged within 48 hours of harvesting and is ready for immediate consumption. Customers will benefit from guaranteed size, quality and taste and a truly sustainable product, the company said.

"Now is the time to look at organic, sustainable sources of fish."

Managing director Karol Rzepkowski added: "No Catch speaks to a growing demand for real, high-quality food for consumers with a conscience. We are committed to creating viable, sustainable solutions for the seafood industry. Given the current issues of pollution and overfishing in our seas, now is the time to look at organic, sustainable sources of fish."

The company works in close association with environmental organisations including the Soil Association, Marine Conservation Society and the Organic Food Federation. Together with the RSPCA, it is pioneering a 'Quality of Life' project to provide a 'fish friendly' habitat. Examples include the provision of shade, toys (for habitat enhancement) and chewing and grazing materials.

The company has said it plans to increase production to four million cod (16,000 tonnes) by 2010 – around five per cent of the total UK cod market. A project to cultivate edible seaweed alongside the cod pens is also being developed.

Johnson Seafarms' pre packed cod fillets will be available from fine food retailers and selected stores this month.

Production is set to increase to four million cod by 2010

Fish Update, March 2006

How many mouths? How much to give?

AN effective and efficient feeding regime requires accurate information on the number and size of fish being fed.

Vaki Aquaculture continue to lead the way in keeping fish farmers around the world reliably informed on the number and the size of fish from fry to harvest.

From Arctic charr in Iceland, cod and salmon fry & smolts in Scotland to turbot, bass, and bream juveniles on the Continent and even tropical fish in the Brazilian Amazon, Vaki counters are utilised to count fish of all sizes and species. The Micro/Macro range of counters combine high speed, accurate counting with size analysis and weight distribution. The well boat versions of this counter offer a reliable starting point for both smolt counts into sea cages and when pumping out larger fish for grading and harvesting.

Size does matter and the Vaki Biomest frame has become the most widely used automated weight estimation equipment in salmon farming. Continual development in partnership with all the major producers has resulted in a fast, reliable and easy to use system for routine weight sampling in sea cages.

Vaki supply the tools that have become vital in ensuring that feed is utilised to best effect, minimising costs and maximising growth potential and payback for your investment.

Pumping, grading and counting cod juveniles in Shetland

Fish Update, March 2006

Fish health on agenda at Cefas conference

Scientists at the Centre for Environment, Fisheries & Aquaculture Science (Cefas) hosted a conference for coarse and ornamental fish farmers at their Weymouth laboratory recently. The conference, entitled "Working Together to Control Disease", was organised to support a government initiative to encourage the development of farmer discussion groups.

Speakers from Cefas, the Environment Agency and the Department for Environment, Food and Rural Affairs (Defra) covered such topics as new fish health legislation, emerging fish diseases, the EU's Water Framework Directive, the role of an aquaculture development officer, codes of practice for fish farmers, and the future development of the new trade association.

Eric Hudson of the Fish Health Inspectorate (FHI), part of Cefas, said: "Providing the fish farmers with an opportunity to tour the laboratory, learn about the work of Cefas, and ask questions went a long way towards developing greater understanding and closer working with the industry. The fish farmers present voiced their thanks for this opportunity."

Fish Update, March 2006

Chinese carp regains access to EU market

AQUATIC products from southwest China's Guangxi Zhuang Autonomous Region have regained market access to the European Union after a four-year ban.

Forty tonnes of African crucian – a type of carp first introduced into China in the 1970s – exported by the Guangxi-based Hong'en Aquatics Co Ltd, passed customs quarantine checks to go into the Netherlands earlier this month.

The company said it raised the fish especially for the EU market starting from December 2004. A batch was examined by EU food safety experts at the customs facilities in in Rotterdam, where it was found to match up to the EU's safety standard.

The EU suspended the export of animal food from China claiming to have verified chloromycetin in shelled fresh shrimps from the country in January 2002.

The embargo was not rescinded until August 2004.

In order to help local aquatic exporters regain access to the EU market, the Guangxi Provincial Quality Supervision Inspection and Quarantine Bureau sent experts to inspect local aquatic farms and carry out on-the-spot quarantine checks using EU's safety standard.

The subtropical region to the northwest of southern China's Beibu Gulf has favorable natural conditions for aquatic breeding. African crucian raised in fish farms in coastal Beihai City in the region has been recognised by the Chinese Ministry of Agriculture as one of the best in quality in the country.

So far, the region's annual output of African crucian has reached 300,000 tonnes.

Fish Farming International, March 2006

Barramundi to be hatched and harvested in the UK

EUROPE'S largest indoor barramundi farm is expecting its first commercial harvest this month.

Built in a little over 12 months, New Forest Barramundi is sited in a former pizza factory near Lymington. Several million pounds of investment, an ambitious build schedule and the collaboration of a team of experts has seen the factory transformed into a world class fish farm.

An organic standard for farmed barramundi could be developed

Concerns about sustainability and the environment were at the heart of the farm's development. It uses state-of-the-art recirculation technology, which has been pioneered in Norway over the past 20 years. The system enables nearly all water used to be recycled – up to 99.68% – reducing demand on local water supplies.

In addition, computerised controls such as water and air temperature, dissolved oxygen and pH levels ensure the fish are grown in a pristine environment.

"Sustainability simply makes good business sense and we are exploring this further by looking at developing an organic standard for farmed barramundi," Managing Director Les Green said.

The farm is also providing local employment opportunities with many staff living in and around the New Forest including graduates from Sparsholt College, one of the UK's leading aquaculture centres.

Although initial stocks of fingerlings have come from Australasia there are plans to build a hatchery, due for completion at the end of 2006. This will mean future supplies of fish will be uniquely hatched and harvested in the New Forest.

Fish Update, March 2006

Code is major step forward for Scottish industry, says Minister

By Christina Reid

THE launch of the Code of Good Practice for Scottish Finfish Aquaculture has been heralded as a major step forward by the Deputy Minister for the Environment and Rural Development, Rhona Brankin.

The code was officially launched on March 15 at a reception in Edinburgh attended by Ms Brankin, MSPs, members of the Ministerial Working Group on Aquaculture and fish farmers.

Launching the code, Ms Brankin said: "It represents a major step forward, one I'm confident will lead to a further raising of standards within the Scottish industry. Another step towards delivering a sustainable, diverse, competitive and economically viable industry in Scotland, an industry which is hugely important to Scotland."

Andrew Jackson, Chairman of the Scottish Salmon Producers' Organisation said 90% of the salmon farming industry has committed to the code. He said ministerial recognition of it is "heartening" for both those closely involved in its creation and the industry as a whole.

"The Code of Good Practice is a major achievement for Scottish finfish farming and clearly demonstrates the progress that Scottish aquaculture has made over the last 10 years," he said.

"The fish farming community is obviously keen to participate in it and demonstrate the very high standards of husbandry and environmental management on fish farms today in Scotland."

The launch was attended by politicians, stakeholders and fish farmers

The Code, which has been in effect since January 1, comprehensively sets out the standards that farmers must demonstrate. Compliance will be independently audited by UKAS-approved Inspection Services and the Code of Good Practice Management Group, independently chaired by Professor Phil Thomas, will provide a forum for discussion about new developments, scientific findings and emerging issues.

Speaking to *FISHupdate* after the launch, Ms Brankin said the industry is showing signs of renewed confidence after a "difficult" time.

Andrew Jackson, Rhona Brankin and Phil Thomas

"I see a big difference coming back into this job after a number of years away. I see very much a recognition of, certainly across parties in the Parliament, the importance of the aquaculture industry to Scotland and I see a very genuine engagement between the industry and the environmental NGOs. It's a much more constructive engagement than existed five years ago," she said.

Commenting on industry concerns regarding the soon to be implemented Aquaculture and Fisheries Bill, Ms Brankin said she believes the Bill and the Code can work side by side without conflict.

"Obviously we haven't finalised our views yet, we're still looking at response to the consultation. But what we need to be able to do is to ensure that any regulatory framework is proportionate and doesn't impose undue burdens. The key word in all of this is sustainability and it's in everybody's interest to have a sustainable aquaculture industry," she said.

Fish Update, March 2006

Shetland to launch organic farmed cod

ORGANIC cod fillets from fish farmed in Shetland are soon to be launched throughout the UK.

Shetland-based Johnson Seafarms claims to operate the world's first sustainable organic cod farm and has announced the launch of its 'No Catch... just cod' brand.

The pre-packed fillets will be available from fine food retailers and selected stores from April.

The company says the brand name 'No Catch... just cod' refers to the diminishing wild cod stocks worldwide and the sustainable alternatives it has created.

Laurent Vigulé, chairman of Johnson Seafarms, said: "No Catch is the future of fish. We offer a superior-quality cod with firm white flakes and unbeatable taste, which has been reared in a highly sophisticated, pristine, environmentally sensitive, sustainable environment.

"No Catch is always fresh with no additives and is never frozen – it's just 100% organic, sustainable cod. We're immensely proud to introduce such a unique product to the UK."

A newly equipped fish processing plant in Scalloway is recruiting workers and is ready to go.

Family-owned Johnson Seafarms and its predecessor firms have a 20-year history in salmon farming. It works with environmental bodies including the Soil Association, Marine Conservation Society, Organic Food Federation and the RSPCA.

Fishing News, 17 March 2006

Aquaculture education database

AQUA-TNET. a higher education forum led by AquaTT, has a mandate to assess, compare and analyse the state of the aquaculture tertiary education sector in Europe, and to identify key curriculum development and assessment objectives leading to the dissemination of best practice and a more open, transparent and innovative system of education provision.

AquaTT is committed to the development of future generations of aquaculturists Future successful aquaculturists will require a new range of competencies, in addition to the skills they develop in current tertiary or vocational training, given a rapidly changing industry which is increasingly adapting to new technology. legislation, and new consumer demands.

While monitoring the changes taking place in the European Education Area, the network identified the need to collate all tertiary level course information into one database. which could he accessed by students and workers on an international basis

In 2002 the AquaTT-led project "PISCES" revised and updated the database to include vocational level and short professional training courses' information.

To visit the education database go to: http://www.piscestt.com/pisces/educational/default_en.asp

Fish Update, March 2006

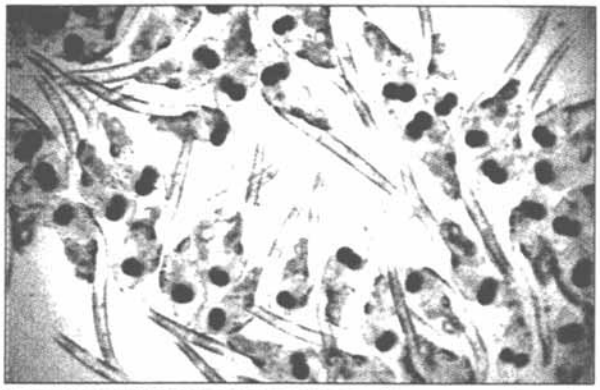
First fertilised cod roe sold

THE FIRST fertilised roe from Norway's national breeding programme for cod has been sold to a fry producer, announces Fiskeriforskning.

"This is a milestone for the breeding programme," says Øyvind Hansen at Fiskeriforskning, who has been responsible for the practical work with the first roe delivery. Twenty litres of fertilised cod roe were picked up from the hatchery and flown to a fry producer in western Norway.

The roe was produced by the first generation of breeding cod. In two to three days, the roe will hatch into larvae and will later become fry, growing up faster than the previous generation, according to Fiskeriforskning.

"This roe was selected from the cod families that have shown the best properties as concerns weight and disease resistance," says Kjersti Fjalestad, who leads the work at the National Cod Breeding Centre.



Fiskeriforskning says the cod larvae from roe produced from its breeding programme will grow at a fast rate

The National Cod Breeding Centre is operated by Fiskeriforskning and is located outside Tromso.

Fish Farming International, March 2006

Skretting launches new larval feeds

A NEW range of marine hatchery feeds for seabass and seabream is being introduced by Skretting.

"The Spectrum feeds portfolio provides a total feed strategy for marine fish hatcheries, including feeds specifically for broodstock, live feeds and products to suit differing approaches to breeding and raising marine species," explains Eamonn O'Brien, head of a newly formed Hatchery Feeds group in Skretting.

"We have improved feeds already in the Skretting catalogue, such as Gemma Micro artemia replacement, and created totally new feeds to achieve a comprehensive portfolio of marine hatchery feeds."

The first Spectrum feeds will be demonstrated next month at Aqua 2006 in Florence, Italy (see page 30). Others will be introduced in the months that follow. To bring Spectrum feeds to the market Skretting has appointed a global network of sales and technical service specialists.

"They bring the strength of Skretting's knowledge of the market and our experience in feeds and feeding to reinforce the value offered in our Spectrum portfolio," says O'Brien.

"The team is technically qualified and experienced – for example it includes several veterinarians."

Hatchery team members for the Mediterranean region who will join O'Brie on the Skretting stand in Florence include Veerle Courtens (for Italy and Greece), Julio Docando (Spain and Portugal), Laurent Duprat (France) and Ilkay Ustdal (Turkey).

"Our intention with Spectrum and the team is to tackle and eliminate current bottlenecks in hatchery production," says O'Brien.

"We are aware of the need to optimise efficiency by improving performance and significantly increasing the consistency and reliability of production cycles. We want the lives of hatchery managers and their technical teams to be easier and more predictable.

"We began by listening to people at marine hatcheries in several regions then bringing together their concerns and wants. It was clear from the feedback that many marine hatcheries really need better feeds and they look to Skretting as a company with a strong R&D record to provide them.

"These views gave us the inspiration and guidance that ensured we were moving in the right directions, tackling the real difficulties in marine fry production.

"In the development of the Spectrum portfolio we turned to next-generation innovations that take hatchery live and dry feeds onto a higher level.

"At Aqua 2006 we shall demonstrate a new Gemma Wean high protein, low fat diet to complement live feed and compensate for any variations in quality that occur in the live feed. The cold-extrusion Spherizer Agglomeration production process exclusive to Skretting is much gentler on the feed raw materials, giving a diet that is nutritionally richer and better balanced than ones manufactured by traditional methods.

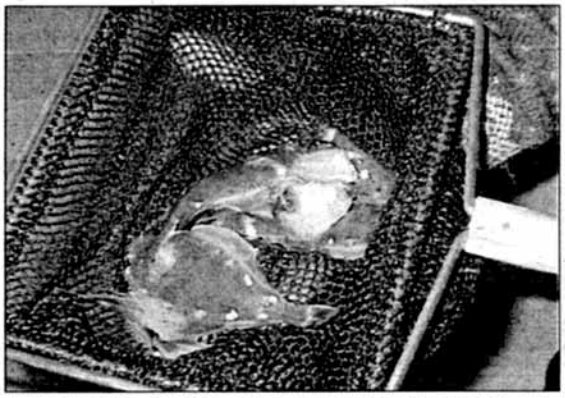
"We will introduce a new Gemma PG, a pre-grower feed produced using the same patented technology. It is carefully matched to the amino acid needs of pre-growing juveniles. Trials show it provides excellent value with fast and efficient growth. The energy content is progressive over the three sizes offered, to suit the growing fry.

"In addition we shall have Perla MP, an innovative concept of feed micro-pellets. Production steps include using only very high quality raw materials and high precision extrusion processes through laser-cut dies ensure the optimum micro-pellet form. Perla MP will be available in a series of sizes, enabling the fish to progress easily onto a transfer diet.

"The complete marine hatchery feeds portfoliowill have seven feed ranges. Just as seven rainbow colours combine in brilliant light, the Spectrum portfolio offers a bright future for marine hatcheries."

Fish Farming International, March 2006

Study points way to growing more female halibut



Halibut juveniles – the Akvaforsk researcher has been looking at ways to produce more females to achieve higher profits

A RESEARCHER at Norway's Akvaforsk instutute has found one of the key factors that influence the sexual development of halibut larvae.

Solveig van Nes' solution is simple – use the same temperature as the ocean. As females grow significantly larger than males, farmers can now direct their production toward fewer males and higher profits, according to the scientist.

Van Nes has just presented her research findings in her doctoral dissertation, at the Norwegian University of Life Sciences (UMB).

Halibut is in high demand, especially female halibut as they become much larger than their male counterparts. Because of the favourable characteristics of the female halibut, van Nes wanted to find a method of increasing the number of farmed females.

The sexual development of fish larvae in several different species appears to be sensitive to temperature. Therefore, van Nes thought it was interesting to investigate whether temperature affected the sexual development of farmed halibut.

In the wild, halibut larvae live at a temperature of 5 to 7°C, whereas in fisheries the temperature is 11-13°C.

The advantage of the high temperature is that it accelerates the growth of the larvae, which then develop more quickly through the demanding larva stage and into a more robust stage.

In her research, van Nes found that increasing water temperature in the larval stage resulted in a larger number of males. At 13°C during the larva stage, 62% of the larvae developed into males.

She also examined several genes that are involved in sexual development, and successfully isolated two aromatase genes responsible for the production of the female hormone estrogen.

One of these genes proved to be particularly sensitive to temperature, thus hampering estrogen production at high temperatures. This is the reason for the large number of males that develop at 13°C.

In contrast, this aromatase gene is more active in cold water, causing more halibut larvae to develop into females, so that the proportion of males to females is close to 50-50.

Van Nes says she is not surprised that temperature provides the best conditions for the sexual distribution of fish, as this is also true for several different species.

"However, it is not always easy to evaluate the effects of temperature on important characteristics during production," said the doctoral candidate.

"If we conduct more research in this field, we will have a basis for re-evaluating the optimal temperature for halibut."

Van Nes, from Halden, Norway, has a master's degree in marine biology/genetics from the University of Groningen in the Netherlands. She defended her doctoral dissertation on January 20.

Her adviser has been Dr Øivind Andersen of Akvaforsk. The evaluation committee consisted of Dr David Penman (University of Stirling), Dr Mariann Rand-Weaver (Brunel University) and Dr Hans Magnus Gjøen (UMB).

The title of her lecture was 'Applications of Research of Sex Determination in Aquaculture'.

■ www.akvaforsk

Fish Farming International, March 2006

Juveniles benefit the Natural way

A NORWEGIAN biotechnology company is ready to unveil to the industry results of trials showing that its recently introduced natural feed product can drastically reduce many of the problems encountered in marine juvenile production, particularly deformities.

The aptly named Natural ASA last year unveiled its product Omagalec, a marine phospholipid that provides farmed fish with nutrition as close as possible in form and type to what the wild fish would use.

"We tried it on 1.5m fish in west Norway, and preliminary trials showed that it reduced deformities, especially 'stargazing' in cod, by around 90%," product director Hogne Hallaraaker tells *FFI*.

"We've also tried it on halibut and we've gone straight into commercial trials."

The halibut trials dealt with eye migration – a big issue in juvenile production in the halibut farming sector – and Hallaraaker reveals that one hatchery experienced improvements in this respect "of between 35 and 90%", he says.

There are also other preliminary results on cod, where gill deformations improved by around 50%, which Hallaraaker points out can not be achieved with most of the synthetic products on the market.

Key to the success of the Natural product is that is – as the company name suggests – completely natural, mimicking what the fish naturally need as much as possible.

Hogne Hallaraaker: 'Great expectations for this product'

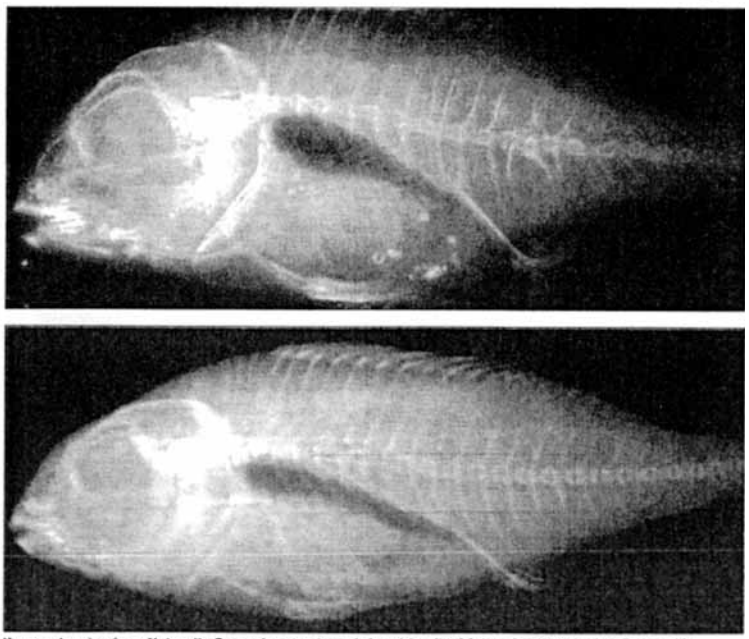
Natural's work has already been recognised with an Innovations award at last year's AquaNor show in Trondheim. Now the company is expanding its reach and Hallaraaker hopes to introduce the product to the wider industry during next month's big Aqua 2006 event in Florence, Italy (preview – page 30 of this issue).

In the meantime, the company has also been in touch with feed companies and, all in all, Hallaraaker has "great expectations for this product".

Containing high levels of natural DHA and EPA, he is sure that Omagalec can have applications in the wider industry, including the shrimp sector, where it can have applications on larvae and juvenile production.

FFI will report on how the product is received at the Italy show in our forthcoming Feeds feature in June.

■ www.natural.no



X-rays showing how Natural's Omagalec can turn deformities (top) into a healthy marine fish profile

Fish Farming International, March 2006

Natural antioxidants are almost as effective as synthetic says research

ANALYSIS by the Norwegian research institute Fiskeriforskning shows that natural antioxidants in fish oil and fishmeal are almost as good as the synthetic ones being used by feed manufacturers today.

In the production of fish feed it is still common to use synthetic additives, or antioxidants, to prevent the feed from oxidising and losing quality. In Europe, and particularly in Germany, consumers are about to turn their backs on synthetic additives.

Fiskeriforskning was selected to conduct analyses of natural and synthetic antioxidants on assignment from Naturland in Germany. The results show that the natural additives are almost as effective as the synthetic, which are used extensively in the industry today. One of these synthetic antioxidants is ethoxiquin (EMQ), which is prohibited for use in foodstuffs in the EU, Japan and Canada. However, it is permitted for use in animal feed.

"Use of legal quantities of synthetic antioxidants are not proven to be dangerous for humans", says Senior Scientist Jan Pettersen who has carried out the analyses, "but there are enough alternative natural compounds that can be used in the production of fish feed."

The tests have been done using methods developed by Fiskeriforskning and show that the different antioxidants work differently according to which products they are used on. For example, the tests showed that ethoxyquin is effective in stopping the oxidation in fishmeal, but has insignificant effect on fish oil. The report stresses that additional research is necessary to document how the nutritive value in feed is affected by use of the antioxidants, and whether there are health-related problems associated with these additives.

Consumers are about to turn their backs on synthetic additives

Fish Update, March 2006

Partnership launched at Stirling organic aquaculture conference

Certified sustainable sources of fish meal and oil to be developed

By Christina Reid

THE Soil Association, Marine Stewardship Council (MSC), Waitrose and processing company Aquascot have launched a partnership to develop certified sustainable sources of fish meal and oil for organic farmed fish diets.

A target date of 2010 has been set, by which time all fish meal and fish oil incorporated into Soil Association organic fish diets should come exclusively from MSC-certified sources.

Speaking at the Soil Association's recent aquaculture conference, held in Stirling, Soil Association Scotland Director, Hugh Raven, said: "Consumer expectations of organic production are that it should be sustainable at every stage.

The partnership announced intends to ensure those expectations are met with regard to feed for organic salmon.

"This partnership is breaking new ground. Without sustainable feed, there will not be a farmed salmon industry into the future. This isn't some distant threat we can leave to our children to resolve. Supplies of fish oil are running short. The industry must get real and start looking seriously at where it is going to get its most important raw material.

"There are concerns within the organic movement regarding environmental and welfare aspects of fish-farming, but with two-thirds of the world's fisheries fully - or over -exploited, we have a responsibility to engage with this rapidly developing aquaculture sector."

Rupert Howes, Chief Executive of the Marine Stewardship Council said the rapid growth in output is placing a huge strain on the wild capture fisheries used to produce the essential fish meal and fish oil component of farmed fish diets.

"The underlying sustainability of these fisheries is perhaps the greatest sustaina-bility challenge that the aquaculture industry faces. As a major user of fish meal and fish oil the rapidly expanding salmon farming sector is particularly vulnerable to potential supply limits of fish oil and meal," he said.

"Our partnership will be approaching a range of fisheries to enter the assessment process for certification. Several sources are likely to be required so as to ensure security of supply and avoid over-reliance on, or exploitation of, any single fishery."

Jeremy Ryland Langley, Fish Buyer, Waitrose said: "Waitrose fish buying policy supports the development of sustainable aquaculture and is committed to securing its future by working in partnership with The Soil Association, The Marine Stewardship Council and our supplier, Aquascot.

"Our commitment also extends to increasing customer awareness of sustainability issues through providing an informative set of fish information pages on Waitrose.com/farming, as well as leaflets in our branches and specialist staff on our service counters."

Pictured are some of the speakers at the organic aquaculture conference

Around 100 delegates attended the Soil Association's aquaculture conference, 'Organic salmon – setting the standard', which was held in Stirling on March 23.

Fish Update, April 2006

Commission proposes new alien species measures

THE European Commission has proposed measures to regulate the introduction of non-native species in aquaculture so as to prevent their possible negative impact on the surrounding environment.

Non-native or alien species, such as rainbow trout or Pacific oyster, have played a crucial role in the rapid growth of the European aquaculture industry. However, in some cases, the introduction of non-native species can have an adverse impact on ecosystems and cause significant loss of biodiversity.

Non-native species include the Pacific oyster

Development

These measures would therefore regulate the introduction of such species through the setting up of a permit system. The Commission says the proposal, which was subject to wide consultation with stakeholders, would not only enhance the protection of ecosystems but would also contribute to the continued development of the aquaculture industry.

"Aquaculture plays an increasing role in our fisheries sector. Diversification is essential to its continued development, as is the need for a balanced and healthy environment. These measures will help ensure that the two are more compatible," commented Joe Borg, European Commissioner for Fisheries and Maritime Affairs.

The core of the present proposal is the establishment at national level of a system of permits for all new species which are introduced for aquaculture.

Under the proposed measures, all projects to introduce a non-native species would have to be submitted for approval to a national advisory committee, which would determine whether the proposed introduction was 'routine', or not. In the case of non-routine introductions, an environmental risk assessment (ERA) would have to be carried out.

Permit

Only movements which are assessed as being low risk could then be granted a permit. If the risk was considered to be medium or high, the advisory committee would enter into dialogue with the applicant to see whether adequate mitigation procedures or technologies which could reduce the risk to an adequately low level were available.

In the case of non-routine movements, the proposal provides for quarantine procedures, and in certain cases, the national authorities may also require a pilot release to be implemented prior to full-scale commercial introduction. The proposed regulation also sets out a number of requirements concerning contingency plans, monitoring procedures, and the keeping of national registers.

Movements

The scope of the current proposal is limited to movements of fish stocks which fall under the Common Fisheries Policy. Ornamental fish are therefore not concerned by these measures. The spreading of parasites and pathogens is already covered by Community legislation on animal health, so this issue is not addressed here either. The Commission says it is aware of the problems potentially posed by genetically modified organisms, but believes that these are best addressed by the substantial and evolving Community legislation specific to this field.

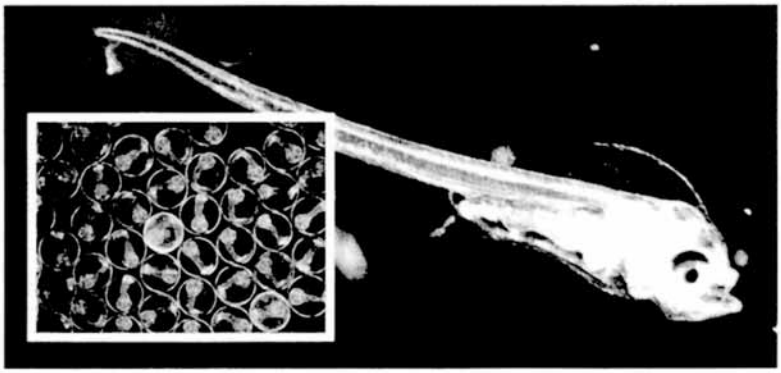
The Commission says the new measures should not lead to undue delays as strict time limits are set out in the proposal. Member States will decide who pays, but it is envisaged that industry will normally bear the cost. The Commission says aquaculture operators could form associations to share the costs. As the permit can cover a five-year period, costs should not hinder the future development of aquaculture, it says.

Fish Farmer, May/June 2006

Another use for Pyceze®

PYCEZE® (Bronopol BP 50% w/v) produced by Novartis Animal Health, licensed for treatment and prevention of Saprolegnia in Salmonids, is now being investigated for its antibacterial properties in aquaculture.

The active ingredient in Pyceze® is used as a preservative in healthcare and cosmetic products and disinfectant for potable water. *Fish Farmer* Magazine reported the successful disinfection of live feed for cod larvae with Pyceze® (14. Fish Farmer Nov/Dec 2004) by Jim Treasurer, Ardtoe Marine Laboratory (AML). Following this work AML have successfully treated cod and haddock eggs with Pyceze®. Eggs were exposed to a 45 second dip at 50mg to 1000mg bronopol/litre. Bacterial numbers on cod eggs were reduced to 30 CFU/ml and zero respectively compared to 14,000 CFU/ml with no disinfectant. At 500mg bronopol/litre haddock eggs also showed a significant reduction in bacterial numbers.



Early cod development

Survival of cod eggs after Pyceze® treatment was higher (83 to 89%) compared to negative controls (48%). Hatching larvae survived exposure to Pyceze® but not to 25% peracetic acid and hydrogen peroxide, a traditional disinfectant of marine finfish hatcheries.

The use of a 30 minute bath treatment, 50mg bronopol/litre, was also investigated in the incubation unit, removing the need to handle eggs. Bacterial numbers were reduced to 892 CFU/ml compared with 91,400 CFU/ml in controls.

Safety studies with haddock eggs, 5x target concentration for 2x duration, gave significantly higher survival (88.7%) compared with controls (53.1%).

Fish Farmer, May/June 2006

US: Intelligent scarecrow developed for aquaculture

UNIVERSITY of South Florida computer science students have built and tested an intelligent scarecrow that guards fish farm ponds from predator birds through image processing and loud, artificial gun blasts and water cannons.

The Erebus Scarecrow – designed by USF computer science students to protect both the investment of aqua-farmers and the lives of birds that may prey upon their fish - is full of sophisticated but relatively low cost sensors, cameras and other hi-tech computer components that will keep predator birds away from fish farm ponds without harming the birds.

Erebus was born in the USF College of Engineering as just one of the novel projects during this semester's Senior Project in USF professor of computer science Ken Christensen's class.

Detects motion

The smart scarecrow detects motion and then uses cameras and image processing software to discriminate between intruders and non-intruders using programmed color recognition. Erebus is "armed" with a speaker system that blasts 120 decibels of gunshot sound and hits predator birds with high speed but harmless streams of water. Erebus can email the user or call a user's cell phone to report an intrusion.

Fish farmers working around their ponds can wear an orange vest to identify themselves as "friendly."

Fish Farmer, May/June 2006

Australian radio listeners told fish welfare is a serious consideration

We've found that fish do possess a memory and they do possess a range of signs, physiological signs where their heart rate goes up in response to things

IN the week betorc last month's Australian Veterinary Association's annual conference in Hobart. radio listeners heard that humans need to start treating their fish as being much smarter than previously thought. Dr Matt Landos told listeners to The World Today programme on Australia's ABC Network:

"We've found quite an amazing array of things that really do debunk some of the old theories. We've found that fish do possess a memory and they do possess a range of signs, physiological signs where their heart rate goes up in response to things, their hormone levels change in response to stresses. We see had outcomes for fish when they're stressed over a chronic period where they may come down with a bacterial infection.

There are nervous pathways in fish that are very similar, in fact nearly exactly the same to those that are present in ourselves, from their periphery right up to their brain. And so it's very likely that fish do warrant welfare status.-

Dr Landos highlighted the fact that fish cruelty legislation in Europe is paving the way for a new attitude. and said he hoped Australia would follow suit.

Dr Landos and his associate Dr Richmond Loh work with the aquaculture and wild fisheries sectors and carry out research around the world. Their research indicates that fish, whether they are wild salmon or a pet goldfish in a bowl. do warrant animal welfare status.

Fish Update, June 2006

Fish welfare is high on EU's agenda

A NUMBER of research projects focusing on fish welfare were outlined during a session organised by the European Union at AQUA 2006.

The session was chaired by Mario Lopes dos Santos, Scientific Officer with the European Commission Directorate-General for Fisheries and Maritime Affairs. He told delegates that welfare forms a major component of the EU's strategy for aquaculture, which was launched in 2002.

Sunil Kadri of the University of Glasgow discussed 'Cost Action 867: WELLFISH'. The project, which recently started, aims to provide a forum for exchange between European and national fish welfare research activities. It is hoped that the forum will aid knowledge transfer to new species.

Dr Kadri said there is currently no definitive means to measure welfare in farmed fish adding that the industry needs operational welfare indicators.

The industry needs to find compromises between intensive production and increasing consumer demand for fish welfare. Consumers are increasingly aware of the ethical issues of fish farming.
Hilde Toften

Mario Lopes dos Santos

The next speaker, Geir L. Taranger of the Institute of Marine Research in Norway discussed WEALTH – Welfare and Health in Sustainable Aquaculture. This ambitious project aims to develop an in-depth understanding of the factors affecting the health of farmed fish. It aims to: identify the key development stages – and husbandry practices – in which fish are most vulnerable to stress-induced infections and to prepare good practice guidelines to help improve health and welfare throughout the European aquaculture industry. The project will focus on salmon and sea bass, although the results will probably be relevant across a broad range of cultivated species.

Ethical

Hilde Toften of the Norwegian Institute of Fisheries and Aquaculture Research presented some of the results from the SEAFOODplus project ETHIQUAL – Ethical quality traits in farmed fish: The role of husbandry practices and aquaculture production systems.

She said the industry needs to find compromises between intensive production and increasing consumer demand for fish welfare, adding that consumers are increasingly aware of the ethical issues of fish farming.

Dr Toften said consumers want highly predictable, traceable products which are safe, healthy and of high quality. They want a wide variety of products, produced in an ethical and sustainable way.

The final presentation in the session was given by Tore S. Kristiansen of the Institute of Marine Research in Norway who discussed FASTFISH – a project based on identifying quantifiable indicators of stress in farmed fish. The project is focusing on Atlantic salmon and European sea bass and will run until 2009.

Fish Update, June 2006

Perceived links between diseases explained

By Claire Anderson

AT the Skretting one-day conference at the Crown Plaza Hotel, Glasgow on Tuesday May 16, aptly entitled 'Aqua Exchange – Passion For Fish', Edward Branson uncovered current health challenges for the trout and salmon sectors. Mr Branson highlighted the differences in conditions, clinical signs and pathological findings in fish affected by Pancreas Disease, Sudden Death Syndrome, Heart & Skeletal Muscle Inflammation and Cardio-Myopathy Syndrome.

Linked

These are diseases that are prone to affect the salmon industry. Delegates learned that both Sudden Death Syndrome and Heart & Skeletal Muscle Inflammation leave no obvious signs of the cause of death. Sudden Death Syndrome has only been reported in Scotland and Ireland, whereas Heart & Skeletal Muscle Inflammation has only been reported in Norway though the two diseases have been linked. Mr Branson cleared up confusion about this link.

Like fish with Pancreas Disease, fish that have suffered from Sudden Death Syndrome are found to have antibodies of Salmon Pancreas Disease Virus. These antibodies are not found in fish with Heart & Skeletal Muscle Inflammation indicating that they are different diseases.

Mr Branson also identified diseases affecting trout. He explained that the term 'Strawberry Disease' is often applied in different ways to describe different diseases found in different countries. To alleviate confusion, he continued to describe what we call in the UK, Red Mark Syndrome, but what is known in the USA and Spain as Strawberry Disease.

Recovery

Red Mark Syndrome is found in cooler temperatures and the red marks comprise swollen skin lesions on the surface of the fish that are only skin-deep. There are no other effects, no mortalities and while antibiotics help, fish can recover from Red Mark Syndrome on their own. The cause is probably bacterial and if caught early and treated, it should not prevent fish growing to reach market size and standards. The disease can however affect up to 80% of stock.

On the other hand, only 30 to 40% of stock is likely to be affected by UK Strawberry Disease. With similar red marks to Red Mark Syndrome, the two diseases are almost exactly the same. However, UK Strawberry Disease affects larger fish that are near market size. Vitamin C and Glucans can prevent it and antibiotics can treat it, but the disease has led to rejections by processors. Treated fish require long withdrawal periods, in line with legislation affecting market-readiness of fish after treatment with antibiotics. For many farmers, treatment is not worthwhile, particularly if the fish are already at market stage.

Edward Branson, Skretting one-day conference

Red Mark Syndrome and UK Strawberry Disease exhibit similar symptoms but occur in different conditions and should not be confused.

Mr Branson's 30-minute presentation was well received by delegates who represented all areas of the industry from fish farms and feed companies to trade organisations and researchers. Mr Branson is a recognised specialist in veterinary pathology.

Red Mark Syndrome is found in cooler temperatures and the red marks comprise swollen skin lesions on the surface of the fish that are only skin-deep

Fish Update, June 2006

Cod culture discussed at global seminar

SPEAKERS from Scotland, Iceland, Norway, Russia and Chile discussed advances in cod farming at a seminar held during Aquaculture International.

Welcoming visitors to the seminar, Jim Treasurer of Viking Fish Farms said it had been around four years since a major workshop on cod culture was last held in the UK. Dr Treasurer said there is a global interest in diversification and described cod farming as the most exciting current development in aquaculture.

Oddvar Ottesen of the Nordland Research Institute, Bodo, Norway described the importance of standardising and improving cod production. He outlined the aims of NorthCod, a transnational project financed by the EU regional Northern Periphery Programme.

The northern periphery countries of Iceland, Norway and Scotland, along with Russia, aim to establish a sustainable production of cod fry to promote successful cod farming in northern areas. NorthCod's goal is to address a number of problems that face cod hatcheries and ongrowers in becoming commercially viable. That includes finding better methods for cod broodstock management, control of egg and fry quality and control of sexual maturation.

These problems will be addressed through identification and application of best existing practices across the industry in the North, applied research in specific issues and production of a best practice manual for hatcheries.

Egg quality indicators

Jim Treasurer of Viking Fish Farms discussed ways of establishing egg quality indicators. He outlined the current cod farming situation in Scotland, saying that there are five marine hatcheries and one major cod producer, Shetland-based Johnson Seafarms.

Dr Treasurer said the highly variable and, often poor, quality of cod eggs is one of the main obstacles to consistent and reliable larval production and is a major bottleneck for hatcheries. The objective of this project is to identify practical measures of egg and larval quality that can be used to give a rapid assessment of the quality of individual egg batches. This information will be made available to growers to assess the optimum time for stocking and to identify the most suitable egg batches for rearing. Egg size decreased as the spawning season progressed, as did dry egg weight. Egg survival was highest during the peak of the spawning season when the largest batches of eggs were spawned.

Marine Herlin

Broodstock management

Marine Herlin, a PhD student at Stirling University's Institute of Aquaculture discussed genetic management of cod broodstock. She said national cod breeding programmes are being developed, particularly in Norway and Iceland, but that many commercial hatcheries still rely on wild caught cod or their own captive bred broodstock. One major concern expressed by producers is early maturation which results in loss in growth and increasing feed wastage, plus the potential environmental impact of spawning. The project is therefore investigating the potential role of selective breeding.

Ms Herlin described how DNA fingerprinting can be used to analyse parentage in cod and thus give an insight into the reproductive dynamics cod mass spawning takes.

Other speakers included Agner Steinarsson of IceCod who outlined developments in cod farming in Iceland, Nonna Zhuravleva of the Murmansk Marine Biological Institute in Russia who discussed ways of assessing and dealing with abnormalities in cod production, and Dag Hansen of LOFILAB A/S who gave a presentation on cod production in extensive systems in Northern Norway.

Egg survival was highest during the peak of the spawning season when the largest batches of eggs were spawned.


Nonna Zhuravleva and Agner Steinarsson

Fish Update, June 2006

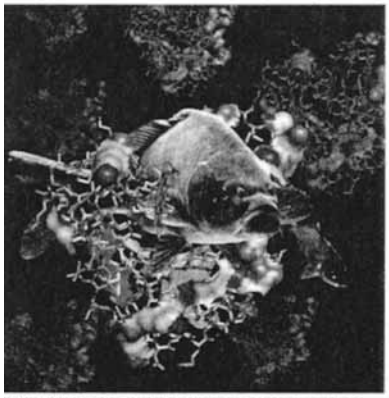
Research at the Institute of Aquaculture

UNIVERSITY OF STIRLING

Prof. Brendan McAndrew is head of the Genetics and Reproduction Research Group at the Institute of Aquaculture. In the article he describes the work to be undertaken at the Institute in collaboration with other UK and European research groups to develop more disease resistant carp strains for aquaculture.
Prof. Brendan McAndrew

Disease and Stress Resistant Common Carp: Combining Quantitative Genomic, Proteomic and Immunological Markers to Identify High Performance Strains Families and Individuals

THIS EU funded project brings together the genetics and vaccine groups in the Institute of Aquaculture with Liverpool University and the CEFAS laboratory in the UK with the HAKI group from Hungary, AKVAFORSK in Norway and two Russian Laboratories VNIRO and FCFGS to utilise their respective technologies to identify and produce more disease resistant carp strains for dissemination to the carp farming industry.



EUROCARP will develop disease resistant strains

The common carp is the third most important farmed freshwater fish species in the world. Eastern European carp genebanks have been responsible for the selective improvement of carp for intensive and semi-intensive pond culture in Europe and their dissemination worldwide. Several serious disease problems such as Koi herpes virus (KHV), and erythrodermatitis (*Aeromonas salmonicida* and *A. hydrophila*) threaten carp farming in many countries. Selection in carp has tended to develop high performing but inbred strains for cross-breeding. The inclusion of disease and stress resistance as traits within selective breeding programmes will require the use of modern quantitative and molecular genetic tools.

Direct challenges

Disease resistance has proved to be a difficult trait to assess and improve in fish, direct challenges on potential broodstock run the risk of turning such fish into carriers. Functional genomics, immune studies and proteomics will identify candidate genes for resistance in fish without a challenge to broodstock. Heritability estimates for viral and bacterial resistance and genetic correlation to performance traits will be assessed. Differences in gene expression within high and low, viral and bacterial, resistance families with and without challenge will be assessed using a 20K gene carp microarray.

Differences in serum/plasma protein expression and immunological parameters will also be assessed. Congruence between expression levels and protein production will provide evidence for the importance of particular genes or gene ontology groups (GO) in these processes. The results from the quantitative genetic and molecular data will be modelled to inform on the optimum design of future practical breeding programmes. This information will be disseminated via established international networks. The project will also develop a second generation medium resolution gene map using microsatellite and Single Nucleotide Polymorphisms (SNPs). This will be an important tool for the future development of improved strains of carp and the identification of commercially important Quantitative Trait Loci (QTL).

The common carp is the third most important farmed fresh water species in the world

The project was initiated at a meeting at HAKI in Szarvas, Hungary over the 8-10 February 2006 and was attended by all the collaborating scientists as well as representatives from the EU.

Fish Update, June 2006

THE FISH HEALTH INSPECTORATE & YOU
Standards of Service – Citizen's Charter
Performance Results

by Debbie Murphy, Fish Health Inspectorate, Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB

Introduction

The Fish Health Inspectorate (FHI) aims to provide an efficient, quality service. Our standards of service have always been high and we are constantly looking for ways to improve them. Under the terms of the Citizen's Charter we are required to publish an annual summary of the results of our performance against the standards set. The results are reported in the Cefas publications '*Finfish News*' and '*Shellfish News'*, which are sent free to all registered fish and shellfish farmers and placed on our web site www.efishbusiness.co.uk. We have recently reworked our Charter and the updated version will also be on our web site shortly.

The use of the web and email continue to grow with an increasing number of callers able to fulfil their requirements by using www.efishbusiness.co.uk, e.g. to obtain forms, students researching projects.

The following report shows the performance achieved against our target of 100%, for the period 1st April 2005 to 31st March 2006.

The total amount of correspondence, and other actions covered by our Charter, recorded by the Inspectorate was 2906. Our performance fully met or approached our targets in most areas. We will continue to strive to achieve all our standards in 2006/ 2007.

Areas where compliance was low included farm registration visits, which in practice are arranged for mutually convenient dates for the FHI and the farmer. We also aim to make these visits as cost effective as possible. The reporting of test results is often delayed where the original inspector may be conducting other routine inspection duties when the results of that investigation become available. It is not always possible for colleagues to report results on their behalf, as they are often unaware of the full circumstances of that disease investigation. Ways to improve our performance in this area are being implemented.

Customer care helpline

The purpose of our work is to prevent the introduction and spread of disease into and within England and Wales. This involves implementing European Union Fish Health Directives and administering and enforcing national legislation. In carrying out this work our main aim is to ensure that you receive a high quality, cost effective service so that your compliance costs are kept to a minimum. The best way for us to measure our performance is to receive feedback from people who require our service. To help us achieve this we have set up a Customer Care Helpline on 01305 206674 where all complaints will be recorded and thoroughly and impartially investigated. Our Helpline staff can assist the customer to formulate the complaint and will explain in full our complaints procedure. They will also aim to send a reply within 10 working days and to ascertain whether the customer is satisfied with the outcome.

Achieved in 2005-06

CORRESPONDENCE

The Inspectorate's target is to reply to all letters, e-mails, applications, faxes and complaints, within 10 working days of receipt.	98.4%

MOVEMENT DOCUMENT APPLICATIONS

The Inspectorate has agreed to respond to all requests for movement documents, provided 5 working days' notice is given.	100%

FISH AND SHELLFISH FARM REGISTRATIONS

Registration visits

The Inspectorate has undertaken to visit all potential farmers within 20 working days of receipt of their application.	58.6%

Registration administration

The Inspectorate aim to complete the administrative action within a further 10 days from the date of the visit.	70.4%

NOTIFIABLE DISEASES

Respond immediately to a notification of suspicion of infectious salmon anaemia (ISA), infectious haematopoietic necrosis (IHN), viral haemorrhagic septicaemia (VHS), gyrodactylosis caused by *G. salaris*, bonamiosis, haplosporidiosis, iridovirosis, mikrocytosis and perkinsosis.	-
Respond to other notifiable diseases within 2 working days.	100%

REPORTING OF TEST RESULTS AND VISIT SUMMARIES

The FHI must report all negative test results within 5 working days of the full results becoming available and give a verbal report within 1 working day where a notifiable disease is found. We have agreed to provide a follow up letter within 10 working days to advise the farmers in writing of any points raised during the visit.	65.8%

OVERALL RESULTS

The overall compliance rate with our set targets.	86%

WHERE TO GET HELP AND ADVICE

Policy Matters

Department for Environment, Food and Rural Affairs, Nobel House, 17 Smith Square, London SW1P 3JR
(Switchboard tel. 020 7238 3000)
(General fax. 020 7238 6591)

Fish farming policy:-
Fisheries Division II, Area 5E, 8-10 Whitehall Place, London, SW1A 2HH
(Tel. 020 7270 8826) (Fax. 020 7270 8827)

Grant Aid:-
Marine Fisheries Agency, Area 6D, 3-8 Whitehall Place, London SW1A 2HH
(Tel. 0207 270 8041) (Fax. 0207 270 8019)

Research and Development Programmes:-
Dr Neil Auchterlonie, Fish Health and Shellfish Health R&D Programme Manager
Area 6C, 3-8 Whitehall Place, London SW1A 2HH
(Tel: 0207 270 8770) (Fax: 0207 270 8020)
(e-mail: neil.auchterlonie@defra.gsi.gov.uk)

You can also visit the Defra website at www.defra.gov.uk/

The Welsh Assembly Government, Agriculture and Rural Affairs Department,
Agricultural Policy Division 5,
New Crown Buildings, Cathays Park, Cardiff CF1 3NQ
(Tel. 02920 823567) (Fax. 02920 823562)
www.wales.gov.uk

Scottish Executive Environment and Rural Affairs Department,
Pentland House, 47 Robbs Loan, Edinburgh EH14 1TW
(Tel. 0131 244 6224) (Fax. 0131 244 6313)
www.scotland.gov.uk/who/dept_rural.asp

Department of Agriculture and Rural Development for Northern Ireland,
Fisheries Division, Annexe 5, Castle Grounds, Stormont, Belfast BT4 3PW
(Tel. 028 9052 3431) (Fax. 028 9052 2394)
www.dardni.gov.uk

Scientific and technical advice

Health regulations and disease control -
Cefas Weymouth Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB
(Tel. 01305 206673/4) (Fax. 01305 206602)
Email: Fish.Health.Inspectorate@cefas.co.uk

Advice is also available via the *eFishBusiness* web site (http://www.efishbusiness.co.uk). This site has information on all the controls that apply to the import or movements of live fish, both nationally and internationally, together with supporting information, including detailed descriptions of the most serious fish diseases and lists of disease-free (approved) areas. All relevant application, registration and notification forms can be downloaded from the site.

Pollutants and their effects -
Cefas Burnham Laboratory, Remembrance Avenue, Burnham-on-Crouch, Essex CMO 8HA
(Tel. 01621 787200) (Fax. 01621 784989)

You can also visit the Cefas website at www.cefas.co.uk

Farm animal welfare -
Department for Environment, Food and Rural Affairs, Animal Welfare Division, 6th Floor,
1A Page Street, London SW1P 4PQ

Environmental issues -
Environmental Agency, Rio House, Aztec West, Almondsbury, Bristol BS32 4UD
(Tel. 01454 624400) (Fax. 01454 624033)
www.environment-agency.gov.uk

Veterinary medicines -
The Veterinary Medicines Directorate,
Woodham Lane, New Haw, Addlestone, Surrey KT15 3LS
(Tel. 01932 336911) (Fax. 01932 336618)
www.vmd.gov.uk

Food hygiene -
Food Standards Agency
Aviation House, 125 Kingsway, London WC2B 6NH
(Tel: 020 7276 8000)

Fisheries Research Services,
Marine Laboratory, PO Box 101, Victoria Road,
Aberdeen AB9 8DB
(Tel. 01244 876544) (Fax. 01224 295511)
www.marlab.ac.uk

Advice on commercial activities

The British Trout Association,
The Rural Centre, West Mains, Inglistone
Mid-Lothian EH28 8NZ
(Tel. 0131 472 4080)
(Fax. 0131 472 4083)
www.britishtrout.co.uk

The Coarse Fish Farmers & Traders Association
Chairman: Bernice Brewster; Tel: 01622 815255;
Email: BerniceACS@aol.com
Secretary: Ian Welby; Tel: 01664 859433;
Email: blueroof@ntlworld.com

Wildlife conservation

Joint Nature Conservation Committee,
Monkstone House, City Road, Peterborough
PE1 1JY
(Tel. 01733 562626) (Fax. 01733 555948)
www.jncc.gov.uk

English Nature,
Northminster House, Peterborough PE1 1UA
(Tel. 01733 455000) (Fax. 01733 568834)
www.english-nature.org.uk

Countryside Council for Wales,
Ffordd Penrhos, Bangor LL57 2LQ
(Tel. 01248 385500) (Fax. 01248 355782)
www.ccw.gov.uk

Scottish Natural Heritage
12 Hope Terrace, Edinburgh EH9 2AS
(Tel. 0131 447 4784) (Fax. 0131 446 2277)
www.snh.org.uk

Other Useful Numbers

Co-ordinator for Defra - CARD R&D
Dr Mark James, Fisheries Resource
Management Ltd,
Coillie Bhrochain, Bonskeid, Pitlochry,
Perthshire
PH16 5NP (Tel/fax. 01796 474473)
www.frmltd.com

USEFUL PUBLICATIONS

Previous issues of *Finfish News* and *Trout News* are available online (http://www.cefas.co.uk).

Readers of *Finfish News* may be interested in the leaflets listed below. These are available by contacting the relevant Department/Agency or via the websites (see contact details in Where to get Help and Advice).

Defra
- A guide to importing fish
- Combating fish disease
- A guide to protecting freshwater fish stocks from gyrodactylosis and other serious fish diseases
- A guide to protecting freshwater fish stocks from Spring Viraemia of Carp

Cefas/Environment Agency
- Controls on the keeping or release of non-native fish in England and Wales

Cefas
- The Fish Health Inspectorate and you – our code of practice and Customer Charter

The following publications are available on the eFishBusiness Website (http://www.efishbusiness.co.uk/news)

- Import of live coldwater fish from third countries: frequently asked questions
- Controls on the keeping or release of non-native crayfish in England and Wales
- Information note on Koi Herpesvirus
- Koi Herpesvirus (KHV)
- Infectious Salmon Anaemia (ISA)
- Infectious Haematopoietic Necrosis (IHN)
- Viral Haemorrhagic Septicaemia (VHS)
- Spring Viraemia of Carp (SVC)
- Gyrodactylosis
- Bacterial Kidney Disease (BKD)
- Furunculosis in salmon
- Lactococcosis
- Category 2 parasites
- Information on various species of non-native fish
- Scientific references on various diseases of fish

Veterinary Medicines Directorate
- Code of practice on the responsible use of animal medicines on the farm
- Veterinary Medicines Guidance Note 15: Controls on the administration of veterinary medicines
- Veterinary Medicines Guidance Note 16: Record keeping requirements for veterinary medicinal products
- Veterinary Medicines Guidance Note 21: Medicated feedingstuffs prescriptions

SEERAD Fisheries Research Services (Aberdeen and Pitlochry Laboratories)
Information leaflets

- How new diseases emerge
- Identifying risk factors for Infectious Pancreatic Necrosis
- *Gyrodactylus salaris*
- What are freshwater lice?
- Supporting new aquaculture species in Scotland
- Scotland's freshwater fish populations: stocking, genetics and broodstock management
- Scotland's Arctic charr
- Scotland's freshwater fish populations – introductions and movements
- Ferox trout
- Water quality in salmon spawning gravels
- How groundwater can affect the survival rate of salmon eggs
- How river flow affects rod catches of Atlantic salmon
- Signal crayfish – an unwelcome addition to Scottish streams
- Grayling
- Pike
- Catch and release – a guide to best practice

Available on the Environment Agency website (http://www.environment-agency.gov.uk/subjects/fish)
- Protecting your fishery from cormorants
- Cormorants, the facts
- Goosanders and mergansers, the facts
- Coarse fish biology and management
- The construction and renovation of stillwater coarse fisheries
- De-oxygenation
- Desilting stillwaters
- Environments for Fish
- Stocking fish - a guide for fishery owners and anglers

The Centre for Environment, Fisheries & Aquaculture Science
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