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The haddock
Melanogrammus aeglefinus,
www.lib.noaa.gov/

Haddock culture: Current knowledge and challenges

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The cod *Gadus morhua* is receiving the greatest current interest in the diversification of north temperate aquaculture, but the haddock *Melanogrammus aeglefinus*, a related gadoid species, is another promising species for culture. The haddock is a popular finfish species in Atlantic Canada and Europe and interest in farming stems from the dramatic collapse of the fishery in eastern Canada and the fisheries in Europe have also been subject to intensive exploitation. Haddock have been grown commercially in New Brunswick and in a demonstration project in Scotland (sponsored by Seafish, Highlands and Islands Enterprise, Marks and Spencer, Aberdeenshire Council, Fisher Foods (now Macrae), EWOS and Mainstream). There are also broodstock fish in Norway. The life cycle and rearing process for haddock are similar to cod, but there are many detailed differences in rearing protocols.

The haddock fishery off eastern Canada collapsed in the 1980s and is taking a long period to recover, and consequently the fishery has been closed for many years. While the catches from the fishery in the North Sea declined in the 1990s due to heavy fishing the EU quota was increased in 2002 following the recruitment of several stronger year classes. The most important fisheries are the North Sea with a reported catch of 54,700 tonnes in 2006 (ICES) mainly by British boats, around the Faroe Islands with 16,800 t captured mainly by local vessels, and 97,400 t off Iceland and largely by Icelandic boats. The other main fishery is the North east Arctic off north Norway and the Barents Sea with the fishery dominated by the Norwegian catch of 69,000 t in 2006 and the Russian landings of 53,000 t. The fish in the European market are normally sold fresh on ice but in the UK many fish are smoked.

Distinguishing marks of the haddock are a black lateral line along a white side, a dark blotch above the pectoral fin, the dorsal fin is long, pointed and crescent shape, and the haddock body appearance is more slender than cod. The haddock is found at depths of 40 to 200 metres and the thermal preference is from 2° to 15°C. Haddock feed on small invertebrates such as mussels, crabs, shellfish and worms, and also consume fish. Growth rates of haddock have changed significantly over the past 30 to 40 years and presently growth is more rapid, with haddock reaching their adult size much earlier than previously reported. The growth of haddock differs between localities and by sex with female haddock generally growing faster than the males.

The main spawning grounds are off the central Norwegian coast, to the south west of Iceland and near the Faeroe Islands. Spawning occurs from January to May, peaking during late March and early April. A female of 40 cm produces approximately 300,000 eggs, and larger females are capable of producing up to 2 million eggs and these are released in a number of batches over a prolonged period. Young haddock spend the first few months of life in the upper water layers feeding on copepods and adopting a demersal habit later.

Broodstock

Farmed haddock can reach sexual maturity at two years of age, or around 750 grams, although fish in the wild may mature at 4 to 5 years old. Spawning at ambient

photoperiod occurs between February and April at temperatures of 6 to 8°C. Females may spawn at different times and individuals may spawn over 15 days, with a few days' interval between each egg batch. Brood fish can be sexed from two months before spawning using ultrasound techniques and ovaries can easily be seen in the scan as a pair of distinct lobes. Alternatively fish can be sexed by gently squeezing along the flanks immediately before spawning to see whether milt or eggs are extruded. Fish spawn spontaneously in captivity, so broodstock are allowed to spawn naturally.

Early rearing

Fertilised eggs are collected from the outflow of the holding tank with a 100 µm plankton net suspended in a tank of water. After disinfection and weighing, the eggs are transferred to cylindrico-conical egg incubators. On the morning following egg collection, aeration and water to the incubator are stopped permitting dead eggs to sink and the viable live eggs to float. The dead eggs are then siphoned daily to maintain incubator hygiene. The dead eggs are weighed and recorded to provide an estimate of percentage survival during incubation. The development time to hatch is temperature dependent but is normally 100 degree days.

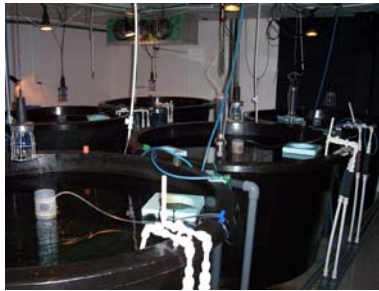
Larval rearing

Larvae should be transferred to larval rearing tanks by gently removing by jug within 24 hours of hatch. Larval haddock are stocked into rearing tanks typically at densities of 50 to 100 larvae per litre. The rearing tank will feature a standpipe surrounded by a fine mesh to prevent escape of the larvae but permit uneaten food to be flushed out. Algae are added on the first day and daily thereafter. On day 1 post hatch (dph) enriched rotifers should also be added to give a density of ca. five rotifers per ml. Haddock larvae fill their swim bladders from the air/water interface during a critical developmental period. Therefore it is necessary to install air-powered surface skimmers on day 1 to clear the surface of oil layers associated with the live feed. Around 25 dph the first enriched *Artemia* should be added, in addition to rotifers. The larvae should be co-fed both *Artemia* and rotifers for one week, and then rotifers and algae withdrawn.

Juvenile stages

Juvenile haddock should be held in tanks until at least 5 g with stocking densities no higher than 15–20 kg/m³ to ensure fish welfare and should also be dip vaccinated against *Vibrio anguillarum* infection at this stage. Haddock have been transferred from the hatchery to sea cages in two stocking strategies. In the first the fish are tightly graded and transferred at c. 5 g, and then graded later at c. 50 g and vaccinated by intraperitoneal injection at sea for atypical furunculosis and *Vibrio anguillarum*. The alternative is to retain the juveniles in the hatchery until they are c. 20-30 g, then vaccinate and allow for a period of immune induction and then transfer the fish to sea cages. The latter plan can be more costly and difficult in terms of nursery resources in a marine hatchery. The juvenile haddock should grow to 50 g in 6 to 8 weeks, when they should be able to withstand transfer to on-growing sites.

Haddock should reach a marketable size in two years.



Early rearing tanks



Larval Stage



Juveniles

Cage on-growing

The cage type used for salmon can be utilised for rearing haddock. However, a double net is desirable to prevent chewing and escape through broken net meshes and to discourage predators. Stocking densities of up to 20 kg m⁻³ are appropriate for haddock. Generally no aggression is seen in haddock once they are above 5 g in weight. The growth of males and females maintained on continuous light regimes with no maturation is not significantly different. The growth of haddock with current diets is slower than cod and typical growth rates of fish are shown (Fig 1). The food conversion rate in farmed haddock is good with values in tanks and cages of around 1.

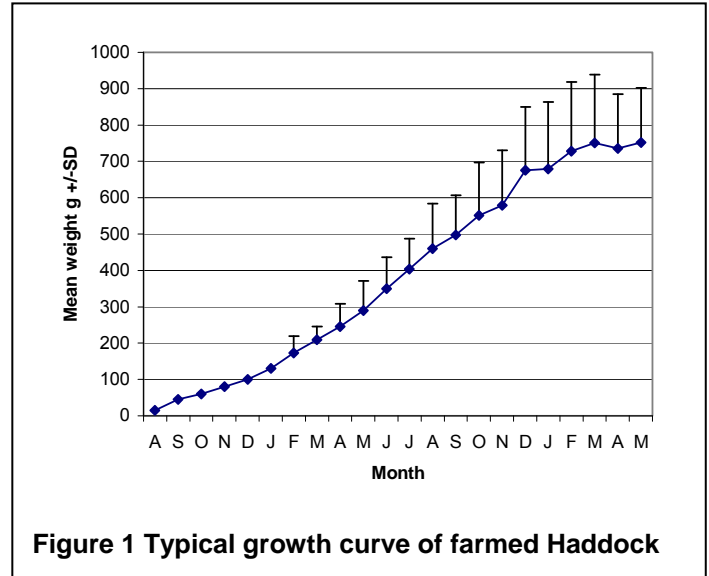


Figure 1 Typical growth curve of farmed Haddock

Diets

Fish can be fed by hand to satiation over c. 30 minutes. Alternatively an automatic feeding system can be used with a feed back loop, such as Aquasmart[®]. The diet used is standard marine diet for marine finfish species. Although these are good diets for cod the lipid content is too high for haddock and the manufacturer should be asked for special production with lipid levels as low as 10%. In practice diets with 12% lipid have been used but these are still not optimal. Haddock are less capable than cod in utilising high lipid in the diet and the lipid is not deposited in the muscle but is stored in the liver, giving the opportunity for enlarged livers. The liver weight should therefore be checked periodically by sampling a number of fish and this is expressed as a percentage of the bodyweight, the hepatosomatic index. The index can be 14% when the fish is 200 g, and 17% by 400 g. Values of over 17% may be common at the end of the second year. The liver index is not related to the size of the fish but is significantly correlated with the age of the haddock

Maturation

Early maturation of haddock has a large effect on the growth rate, giving a loss of around 400 g in weight increment over a two year production cycle. The rate of maturation can be checked by visual inspection of the ovary or testis and the rate of development can also be checked by weighing the gonad and expressing this as a percentage of the fish body weight, the gonadosomatic index. Farmed haddock typically spawn at the end of their second year. Maturation in fish has been found to be triggered by the seasonal light regime with melatonin produced in the pituitary gland initiating a process that leads to maturation. Spawning in tanks can be retarded by the provision of continuous light from the first summer solstice but further investigations of lighting have to be done in sea cages.



Potential haddock broodstock

Diseases

Vibrio anguillarum has been found to be the main health issue to date in farming haddock. Vibriosis is the term applied to a primary infection by a pathogenic *Vibrio* species and this is different from non-specific infections where a large number of secondary or opportunistic *Vibrio* species may be involved. Outbreaks generally in marine finfish can be associated with stress such as high stocking densities, poor environmental conditions and handling. Clinical signs are skin lesions, erosion of fins, especially the dorso-lateral fin, bloated fins, and a sudden increase in mortalities. Diagnosis is by taking a bacterial swab from fresh mortalities or from skin lesions.

Vaccines available in the UK were developed for use with salmon and the serotypes are different from those found in marine finfish and the latter are 02a and 02b, so the protection may not be as effective. Vaccines in use in Norway for cod give protection against a range of serotypes but the vaccines are not licensed for use in the UK. An alternative is for hatcheries or on-growing farms to produce individual autologous vaccines from *Vibrio* strains detected on their own farm.

Other potential health issues are atypical furunculosis, *Aeromonas salmonicida* subspecies *achromogenes*. The indications in haddock are internal haemorrhaging, bloody fluid in the body cavity, and sometimes external lesions. Diagnosis is by taking swabs and checking bacterial growth on agar.

Haddock as with cod can be “carriers” of IPNV without showing clinical symptoms and broodstocks collected from the wild should be quarantined and samples taken for virology testing. Cod can be susceptible to VHS so haddock may also be at risk, but no cases have been recorded in aquaculture for either species.

Parasites that have been recorded from haddock have been the protists *Costia* (Ichthyobodo) and *Trichodina*, and treatment is with formalin at 200 ppm for 30 minutes. The digenean *Cryptocotyle lingua*, responsible for “black spot”, can be seen as spots on the fins, head and back, and can occur in sheltered enclosed sites. Although sea lice have not been recorded as a problem with cultured haddock, the sea lice *Caligus elongatus* and *Caligus curtus* have been reported from wild haddock. The medicines available are those licensed for salmon, for example cypermethrin (Excis[®], Novartis Animal Health) and the oral treatment emamectin benzoate (SLICE[®], Schering Plough). Haddock are not hosts of the salmon louse (*Lepeophtheirus salmonis*).

Most of the work on vaccination and the immune system of gadoids has been focussed on cod. As in other marine fish, haddock have small pelagic eggs compared with salmonids, and work by Yolanda Corripio-Miyar of the Scottish Fish Immunology Centre showed that these hatch into small larvae that have a relatively long period of development of the immune system. The poor inducible antibody response which has been seen in cod is also shared by haddock. This lack of response does not allow the efficiency of protection to be determined by traditional methods. Both cod and haddock have a higher level of Immunoglobulin (IgM) in the serum compared with salmon. Immersion vaccination has been shown to confer protection against *V. anguillarum* although there is no specific antibody production. The immune system of haddock begins to develop at 6 to 7 mm length which is equivalent to 25 to 29 days post hatch (dph). Two pro-inflammatory cytokines in haddock have been expressed and sequenced by Y. Corripio-Miyar.

Flesh quality

Haddock can reach a weight of 700 to 1500 g in 2 years in sea cages and tanks. If lights



**Ardtoe Marine Laboratory
Scotland**

are used to retard maturation there will be no difference in the weights of males and females. If lights are not used harvest and flesh quality will be poor around the spawning period, February to April, and several weeks should be given to allow the quality of the fish to recover. The flesh quality, taste, and texture can be improved by starving the fish for 5 days prior to harvest. The fillet yield for fully skinned and boneless fillets is around 46% for farmed haddock.

Market potential and future

The future of haddock farming will be dependent on the development of favourable market conditions and an improved low energy diet and low lipid diet that will improve growth rates and reduce the fatty liver increment. Although further work is required in improving diets the haddock is an attractive candidate for aquaculture, particularly given the lower abundance of recent year classes in the North Sea. The advantages of farmed fish are in providing a constant and predictable supply of haddock of consistent size and quality.

Step by step guide to a marine water parasite prevention plan (PPP)

Neil Wendover and Cedric Komar, Intervet Norbio Singapore

Introduction

This article has been prepared as a practical guide-line to help small to medium size marine cage farmers within the Asia-Pacific region cope with common external parasites. Read it as a guide-line only as no advice on health management is ever absolute. The steps outlined should help farmers overcome a very serious problem with very simple techniques. The techniques in the guideline must be personalised to your own farm as treatment and dosage might vary according to fish, pathogen and environment. Eventually, these techniques should help improve husbandry and contribute to better profit.

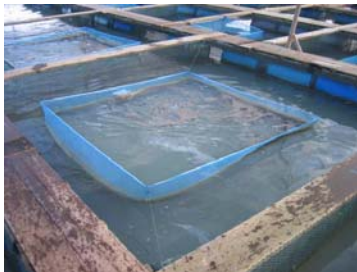
In order to create a personalised Parasite Prevention Plan (PPP) two issues need to be clear;

1. A clear understanding of your own farming situation
2. A good knowledge of marine water parasites present in your farm.

As a reference, background information on the major important parasitic diseases of cultured marine fish in the Asia-Pacific region can be found in the 'Technical articles' located under 'What's new' at <http://aqua.intervet.com>

Below is a list of questions marine fish farmers should ask themselves to get a clear understanding of their farming situation:

- **Know your culture system.** There are two main cage systems in the Asia-Pacific region; Small scale wooden (single or multi species) and large scale single species commercial PVC cages.
- **Know your environment.** Are your cages exposed or sheltered and what is the proximity to other farms?
- **Know your husbandry techniques.** What species do you have, what is the age and size, how long and how big will you grow them?
- **Analyse your production records** for any noticeable trends (or changes) in growth curves, daily mortalities and FCR's. Fish performance and growth is affected by parasitism. This relationship can be observed by comparing performance records between different periods or seasons and by correlating them with parasite outbreaks.



**Small scale wooden
(single/multi species)**



**Large scale commercial
PVC cages**

Parasites can affect the farmed fish in two different ways: Chronic severe disease outbreaks and low grade consistent mortality. In both cases, the detrimental effect of parasites can manifest itself by reduction of growth, poor FCR, loss of appetite and even mortality. Moreover, once fish are infected, they will be more susceptible to concurrent bacterial or viral infections.

Once these farming parameters are known, it is important to know which marine water parasites are in the farm. This is the first step in parasite management:

Step 1: “On site” parasite observation

To identify the parasites on your farm you will need some basic equipment. You will need a microscope, some histology glass slides and cover slips. Firstly, sacrifice a few ‘apparently’ sick and healthy fish for sampling. Using a cover slip, scrape the dorsal side of the fish and smear the mucus onto a slide. For both small and large fish cut out a section of the gills (a gill filament) place it on a slide with a drop of marine water and put the cover slip on top. In order to scan quickly for parasites under the microscope start with magnification x10. Then zoom down to x40 for more detailed species identification. In addition to a microscopic analysis, some parasites are visible with the naked eye. For example, skin flukes such as *Neobenedenia* sp can be seen by simply dipping the fish in a black freshwater bucket for five minutes: parasites will turn from clear to opaque and will be easily seen by observing the water in front of a black background. Other parasites such as isopods and leeches are big enough to be seen with the naked eye.

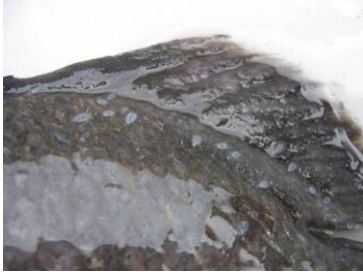
As a reference, pictures of major tilapia parasites can be found in Intervet's AAH Newsletter 14. Species names of parasites in marine water fish might differ from the thoses found in tilapia, however, the shapes of parasites from similar families or genus will look alike independent of the salinity of the water.

Step 2: ‘Paragram’ (Parasite Prevention Programme-PPP)

Once the fish culture system is understood and the parasitic fauna of the farm is identified, it is time to create a personal PPP. To do so, we need to know which treatments are effective for which parasites. For marine parasites, there are various treatments available. These may include synthetic drugs, chemicals and freshwater. Antibiotics are not recommended as part of a regular PPP as they have a specific action towards bacteria and have no effect on parasites.

Before choosing a treatment, appreciate that there may be serious consequences from applying the wrong treatment for the wrong reasons. For example, potassium permanganate becomes toxic in salt water by creation of manganese complexes in fish gills. Similarly, some species are more susceptible to some treatments than others, such as the Humpback grouper (*Altilvelis cromilipetes* sp), which are easily stressed by hydrogen peroxide. It must be emphasized that in most countries, only a few drugs and chemicals have been registered for treatment of food fish. It is wise to consult your local fish health expert before the plan starts as the treatment used must be safe for the fish, the environment and the consumer. It is important to state that any therapeutic compound used on food fish must be legally authorized in the country of use.

Effective treatments and useful suggestions are widely available in books on aquaculture or on the internet. However, do not blindly follow information on fish treatment. It is advised to try a new treatment on a small experimental scale and perform a ‘paragram’ as outlined in this article. To do this, you will need some buckets, infected fish, a range of treatments and an oxygen supply. The oxygen supply can be aeration with an air pump or pure oxygen. In the case of a pure oxygen supply, careful monitoring of the dissolved



***Neobenedenia* sp. (skin fluke) on Asian sea bass**



***Zeylanicobdella arugamensis* sp (leech) on Pompano**



***Rhexanella* sp. (Isopod) on Snapper**

oxygen present in the treatment water is necessary as super-saturation of the water may occur causing 'gas embolism' in the fish.

As a preliminary experiment, three types of treatment can be tested: Hydrogen peroxide which is recognised as a standard chemical in parasite management, formalin and freshwater. Collect some infected fish and split them equally amongst 9 buckets of equal water volume. In each of your buckets place a low, medium and high dose of each treatment. Monitor the presence of parasites on the fish before and after application. An effective treatment should help to eliminate the parasites on the fish immediately after treatment.

Case example:

In the following example, a small scale marine cage farmer has observed gill flukes and ciliated protozoan in his snapper and skin flukes in his sea bass.



Gill flukes in sea bass



Trichodina spp. in snapper

After trying the three types of treatment mentioned above, fill up the following table that summarizes the presence or absence of parasites for different doses and treatments. In general, the efficacy of a treatment is a function of both time and concentration. For instance, at a given concentration, a shorter exposure than what is required might not be effective to kill parasites. On the other hand, a longer application might be detrimental to the fish health, as it is stressful and might cause water quality deterioration. Consequently, the objective of the program is to find out the minimum concentration of each treatment required to eradicate each of the parasite species present on the fish.

Hydrogen Peroxide (ppm)			Formalin (ppm)			Fresh water (salinity/ppt)			Treatment
1hr			1hr			5mins			Duration
Low	Med	High		Low	Med	High	Low	Med	Dosage
80	150	200		60	80	120	20	10	
	OK				OK				<i>Trichodina</i> spp.
									<i>Haliotrema</i> spp.
									<i>Benedenia</i> spp.
Present		Absent							

In this example, our farmer decides he would like to use hydrogen peroxide as a bath treatment for all of his fish at the dose of 150 ppm for 1 hour.

Parasites are part of the natural ecosystem and complete eradication is extremely unlikely. However, by repeating this treatment on a regular basis, the farmer designs his own parasite prevention plan as a way to control the parasite pressure on his fish before it gets dangerous.

Step 3: Step by step to treatment as part of the PPP

As previously mentioned, it is necessary to understand the parasite cycle in order for the treatment to be effective. In our example, fish are infected with capsalid monogeneans that lay eggs on nets to complete their life cycle. It is therefore very important to include the nets in the treatment. The life cycle for this parasitic species is ten days so a preventative treatment needs to occur consecutively within that time frame. Frequency of treatment might vary depending on temperature, parasite and fish susceptibility to parasites. For instance, managing *Cryptocaryon irritans*, a protozoan parasite responsible for white spot disease, necessitates the application of at least four treatments applications in a row every three days. This is due to the existence of an encapsulated stage resistant to treatment in the life cycle of the parasite.

Currently, the most effective technique for managing parasites is to use a tarpaulin treatment as described below:



Tarpaulin enclosure of a small cage

1. Prior to treatment, or handling of any sort, starve the fish as feeding increases metabolic activity and causes undue stress.
2. With back up oxygen ready (either from a pure oxygen tanks or blowers), start to crowd the batch of fish for treatment. The maximal fish density applicable will vary from case to case as tolerance to stress varies from species to species.
3. Prepare the tarpaulin and start to pull it under the cage (ensure the entire net is included as well). Larger cages will need swimmers/divers to drag the tarpaulin underneath.
4. Open the air valves and (using a DO meter) continuously monitor the Oxygen and pH levels).
5. Apply the chemical as a splash treatment and monitor the fish closely for the entire treatment duration. Note that H₂O₂ has the added benefit of removing a certain amount of bio-fouling from nets and depending on the concentration, may temporarily increase DO levels.
6. If at any stage the fish display abnormal behaviour remove the tarpaulin. Signs may include: 'gasping' at the water surface, erratic swimming or 'darting', listlessness behaviour 'hanging' in the water column, separation of individuals from the shoal and or colour changes 'turning black'.
7. After one hour remove the tarpaulin and monitor the fish performance. Wait until you are sure the fish are recovered from the treatment before feeding.



Treatment application including additional aeration

Once satisfied with the procedure in one cage, it is time to apply a plan for the whole farm. Although not always possible, as a global approach to managing parasites, it's best to treat all your fish in one day as opposed to treating different batches day after day. This is simply because of the risk of re-infestation of treated cages from untreated neighbouring cages.

Step 4: Quarantine

This step should be applied for all future incoming batches of fish. Indeed, fingerlings sourced from different farms and/or countries may be excellent vectors for introducing

new pathogens and particularly parasites. Therefore, to quarantine all incoming stock is an important step of the PPP. Quarantine involves a thorough inspection either with the local veterinary authority or a personalised on-site analysis (see step 1) and seclusion.

Locate the introduced batch of fish away from the rest of your stock in a different cage or, even better, a different farm site. Initially treat using a tarpaulin surrounding the cage before the fish can interact with the natural water body. Wait one week for the stress level to reduce and sample for parasites on a few specimens (step 1). When no parasites remain, it is time to re-introduce the stock in your farm.

Once the quarantine stage is over, it is necessary to perform an on-site analysis every week on that batch to monitor the re-emergence of any parasites. Generally, smaller fish are more susceptible to physiological stress and attack by parasites than larger fish. Therefore, the most important checks are during the weeks and months after introduction onto the farm. Once fish reach 200-300 g, they become less susceptible to parasites.

Conclusion

Following this guideline should help Asian-Pacific marine fish farmers to keep parasite pressure under control from stocking to harvest. By doing so, they should be able to accurately compare previous production records to those since implementation and be one step closer to improve future production targets and profit margins.

Finally, it should be kept in mind that parasite management is only part of the overall health picture and that other husbandry techniques are very important and must be conducted on a regular basis as well. For small scale marine fish farming, these measures include net changes, feed management, and strict hygiene standards. Finally, great emphasis should also be put on the management of bacterial and viral diseases.

Infectious salmon anemia (ISA) in Chile, 2007

Sergio Vasquez Intervet Chile

Infectious salmon anemia (ISA) is an infectious disease caused by an orthomyxo-like-virus. It was reported for the first time 24 years ago in Norway. Later ISA was also reported in Canada (New Brunswick and Nova Scotia), the United Kingdom (including Scotland and the Shetlands), the Faeroe Islands and in the USA, Maine. A non-clinical infection has also been detected in sea-reared rainbow trout (*Onchorhynchus mykiss*) in Ireland (2002).

In Chile the virus was first isolated in 1999 from Coho salmon (*Oncorhynchus kisutch*) stock cultivated in the south of Chile, and identified later as ISA virus (ISAV) by Dr. Kibenge at the University of Prince Edward Island. In this case, the fish exhibited atypical signs of ISA infection and the condition was locally called Jaundice Syndrome. The first cases started at the end of summer and initially affected the bigger fish on the site. The main external findings were anemia and jaundice of the mucosa, eyes and abdomen, while internally, the liver, spleen and kidney were swollen. The clinical and pathological picture was complicated by subsequent Piscirickettsiosis. The ISAV diagnosis was done using polymerase chain reaction (PCR) techniques.

After this first discovery of ISAV in Chile in 2001, the country was officially designated by the OIE as positive for ISAV affecting Coho salmon but with atypical ISA symptoms. Since the first ISAV infections affecting non-susceptible species in Chile, there have been some asymptomatic ISAV infections affecting Coho and Atlantic salmon. During July 2007, the ISAV reappeared causing six typical ISA disease outbreaks in Atlantic salmon cultivated in seawater on Chiloe Island, south of Puerto Montt.



**Atlantic salmon site
in Chile**

The recent cases started as an unexpected rise in mortality on affected sites. The sick fish ranged in size between 0.4 & 2.5 kg and were cultivated at an average water temperature of 10 °C. The fish showed the classical external and internal signs of ISA such as pale gills, skin petechiae and hemorrhages, anemia, ascites, congestion and enlargement of liver and spleen. Presence of hemorrhagic ascites in the abdominal cavity and pericardium was also observed. Tissue samples taken for histopathology revealed diffuse hemorrhagic necrosis in the tissues and was highly suspicious for ISA virus infection



Typical ISA signs
in Atlantic salmon

The ISA virus was subsequently isolated with a cytopathic effect (CPE) occurring in Chinook Salmon Embryo-214 (CHSE-214), Epithelioma papulosum cyprinid (EPC) (the 1st time ISA has grown in this cell line) and Salmon Head Kidney-1 (SHK) cell lines after 4–7 days using tissue homogenates of internal organs of sick fish. The presence of the virus was also identified using an indirect fluorescent antibody test (IFAT). Polymerase chain reaction (PCR) was performed using Devold's and Mjaaland's methods, which are OIE approved. The disease was therefore confirmed in Chile using OIE diagnostic methods on 6 sites and was reaffirmed by Norwegian and Canadian experts. A further 10 cases have been confirmed and most of the affected fish have been slaughtered.

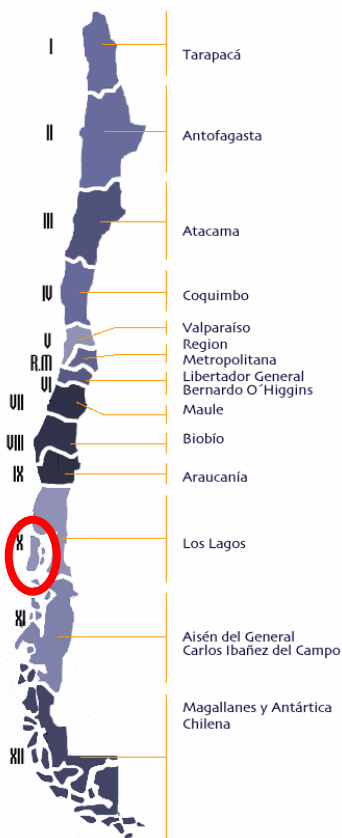
Preliminary sequencing of segments 6 & 7 of the ISA virus from the first outbreak in Atlantic salmon indicates at this time that the virus is similar to Norwegian strains of the virus. Once the disease and the causative agent was officially identified and declared, the Chilean aquaculture agency (Sernapesca) took control of the situation and leads all the subsequent biosecurity and epidemiological measures to ensure the notification of the disease and avoid the spread of the agent in Chilean waters.

Chilean aquaculture regulations require all new diseases and or agents to be notified to the authorities by the company and or the fish health laboratory involved. With this information the Chilean authorities declare an epidemiological alert and implement contingency measures. They aim to identify the ISA virus positive sites and take samples to re confirm the presence of the virus and to identify adjacent sites for quarantine and surveillance measures. The sites in the affected areas have been classified as follows:

- **Positive or confirmed sites:** with or without mortality rises, presence or absence of clinical signs, but with two positive results for ISA virus, checked with the OIE accepted techniques.
- **Suspicious:** for sites that have only one positive isolate or identification and with positive serology to ISA virus.
- **Negative:** for sites that have three main conditions, as no clinical signs or mortality due to ISA virus and no virus identification. This one could be the situation of a site that has been 90 days without any fish.
- **Quarantine Area:** is the area located between a positive site and 5 Km. around it.
- **Surveillance Area:** is for sites that are located more than 5 Km., but related to a suspicious or positive case.
- **ISA Free:** is for sites that do not fill in the definitions above.

The authorities also established biosecurity and disinfection measures and procedures for all the sea sites in order to minimize the possibility of spreading the agent. These measures include, reporting of the weekly mortality, harvest or sacrifice of the affected fish, adequate handling of mortalities, avoidance of any fish movements between sites, etc.

The Chilean authorities declared the ISA cases to the OIE and now Chile is officially recognized as positive for ISA virus causing ISA disease in Atlantic salmon. The fish health laboratories have implemented all the techniques necessary to confirm the virus, which are available for all the Chilean salmon companies in order to detect new outbreaks at Chilean seawaters.



Chiloé Island is focus of
ISA cases in Chile

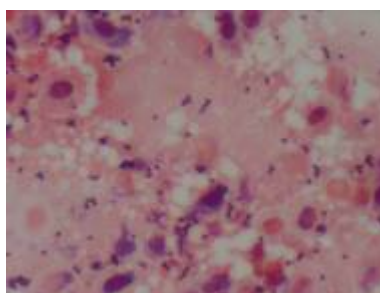
MARINE BACTERIAL DISEASES

Bacterial diseases of finfish in the South East Asian region

Lauke Labrie, Joseph Ng, Cedric Komar and Brian. Sheehan, Intervet Norbio Singapore



[A] Strep. iniae infection in Asian sea bass



[B] Gram positive cocci in Gram stain of impression print of brain tissue from an infected fish.



[C] & [D] Asian sea bass infected with T. maritimum presenting typical mouth and skin lesions.



Fish mortality associated with infectious disease in South East Asia remains high. Often mortality over a typical production cycle ranges between 20-80%. Due to a general lack of diagnostic capacity, epidemiological data with respect to the origin of this mortality is usually poorly documented. Therefore, there was a need to identify the most common and economically important diseases in the region. Intervet Norbio Singapore has been conducting epidemiological investigations in the region in both the marine and freshwater environments over the past 7 years. The focus of this article will be on disease cases of bacterial origin.

We have found that diseases such as streptococcosis due to *Streptococcus iniae* and *S. agalactiae*, nocardiosis due to *Nocardia seriolae*, and infections with *Tenacibaculum maritimum* and *Flavobacterium columnare* are common bacterial infections that affect a wide range of cultured fish species in South East Asia. The table below illustrates the number of isolates, countries investigated and fish species from which the pathogens were isolated. Our investigations and reports from the literature suggest that these diseases are becoming increasingly important as a consequence of the intensification of aquaculture. Photographs of typical disease signs as well as a description of the pathogen involved is given for the major pathogens found in the marine (**Figures A-G**) and in freshwater environments (**Figures H-M**).

Bacterial Species	Number of isolates recovered	Number of different locations sampled	Fish species susceptible for all 3 pathogens	Other species affected	Countries of sampling
Marine environment					
<i>Streptococcus iniae</i>	213	30	Pompano, Snappers, Yellow croaker, Groupers, Yellowtail, Amberjack, Flounder	Asian sea bass, Threadfin, Sea bream	Malaysia, Singapore, Indonesia, Thailand, Philippines, China, Vietnam, Japan, Korea, Taiwan, Australia
<i>Nocardia seriolae</i>	40	10		Threadfin, Trevally, Striped sea bass	
<i>Tenacibaculum maritimum</i>	77	22	Asian sea bass, Sea bream, Red drum, Turbot		
Fresh water environment					
<i>Streptococcus agalactiae</i>	219	22	Tilapia	Catfish	Indonesia, Malaysia, Singapore, Thailand, Philippines, China, Vietnam
<i>S. iniae</i>	75	14		Goby, Puntius	
<i>Flavobacterium columnare</i>	40	16		Japanese & European eel	

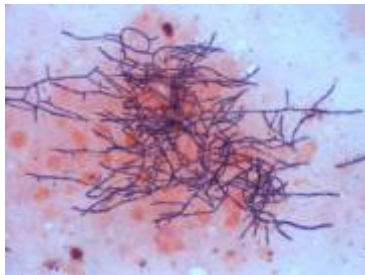
In addition to these more established pathogens, we have recently identified upcoming bacterial diseases potentially harmful for aquaculture species. Infections with bacterial pathogens such as *Edwardsiella tarda* and *Streptococcus dysgalactiae* are emerging in several countries. Moreover, a previously unrecognized disease named Pot Belly or Big Belly disease caused by a facultative intracellular Gram-negative bacterium was identified. Infections with this previously uncharacterized pathogen causes severe visceral granulomatous lesions in Asian sea bass fry < 5 g with an associated mortality rate that can be in excess of 70-80%. Finally, a second granulomatous disease in *Tilapia* sp. due to a *Francisella*-like organism causing up to 50% mortality was identified as an emerging disease in the region.

The table below summarizes the fish species and isolates recovered.

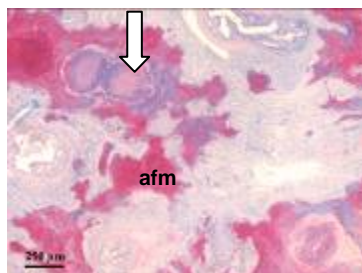
Pathogen	Number of total isolates recovered	Number of different locations sampled	Fish species susceptible	Countries
<i>E. tarda</i>	24	7	Red sea bream, Japanese Flounder, Turbo, Eel, Catfish	Japan, China, Korea
<i>S. dysgalactiae</i>	14	7	Yellowtail, Pompano	Japan, China
Big Belly disease	10	3	Asian sea bass	Singapore, Malaysia, Indonesia
<i>Francisella</i> sp	6	1	Tilapia	Indonesia



[E] Red snapper showing typical clinical signs of nocardial infections: ascites, splenomegaly, macroscopic nodules in spleen (arrow).



[F]: Gram-stain of impression print from infected fish brain showing typical branching Gram-positive hyphae indicative of nocardial infections (oil immersion X1000).



[G]: Modified Ziehl Neelsen stain of severe granulomatous lesions in peritoneum - note massive presence of acid-fast material (afm) at centre and surrounding granulomata (granulomata indicated by arrow head) (X400).

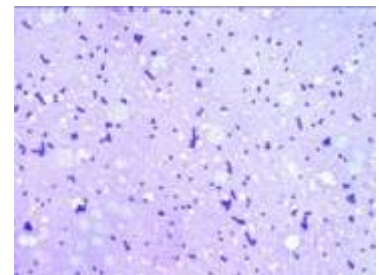
Gross and histological signs of pathogens isolated from the **Freshwater environment**



H & I: Typical gill necrosis and skin lesions after infection with *F. columnare*.



J Typical *F. columnare* growth.



K: Gram stain of a brain impression from an *S. iniae* infected fish.



L & M Typical clinical signs in *Puntias* infected with *S. iniae* showing bilateral exophthalmia.



Intervet Singapore hope to continue monitoring for common and emerging aquatic animal disease in the South East Asia region and will keep cutomers informed of their results.

SCHERING-PLOUGH & INTERVET “GROWING STRONGER GROWING BETTER”

Schering-Plough Corporation announced on November 19th that it has completed the acquisition of Intervet which is part of Organon BioSciences N.V., creating a stronger combined company with broader human and animal health portfolios, an enhanced new product portfolio and increased R&D capabilities. The combination of Schering-Plough Animal Health and Intervet makes Schering-Plough a global leader in Animal Health. We increase our science strength, and we increase our scale in Animal Health,” said Fred Hassan, chairman and chief executive officer, Schering-Plough Corporation. “This greatly increases the value we will bring to customers. We see this strong combined Animal Health unit as a key strategic part of our integrated business that will contribute to long-term high performance. Alistair Brown MD of Intervet Aquatic Animal Health welcomed the announcement “We will be able to offer our customers an even wider range of science based aquatic animal health products and technical support for both prevention and treatment of aquatic animal diseases “

NEWS-FLASH



Intervet at Aqua Nor 2007



Sergio Vasquez & Oscar Parra (Intervet Chile) at Aqua Nor 2007

The worlds largest exhibition for fish farmers, Aqua Nor, took place from August 14-17 in Trondheim, Norway. As always, Intervet Norbio AS had a booth in the busiest exhibition hall. Intervet Norbio staff from all departments of the local company, as well Intervet AAH people from The Netherlands and Chile, participated. This allowed us to meaningfully interact with not only our many Norwegian customers and friends, but also with the many visitors attending from Chile, Canada, Asia and other areas. This year, Aqua Nor consolidated its claim as the leading international aquaculture event through a considerable increase in exhibitors and visitors from more countries than ever.

Intervet Norbio also arranged an **Intervet Agenda Seminar** over two days with both internal and external lecturers. Close to 100 decision makers from customers, potential customers and fish health experts attended one or both of the seminar days. The feedback was very encouraging, motivating us to plan similar and better seminars both at Aqua Nor 2009 and tailor made Intervet Agenda Seminars regionally in Norway during 2008. We would like to thank everyone who stopped by our booth and hope to see you again in two years time, if not before at **Aqua Sur 2008** or elsewhere!

Intervet agenda articles can be found on our new aquatic animal health website under What's new.

<http://aqua.intervet.com>

Some impressions from the 13th European Association of Fish Pathologists meeting, Grado Italy September 17-20, 2007

Eric Rijke, Intervet International

Around 350 participants attended. The scientific program consisted of 127 oral (parallel sessions) and more than 200 poster presentations.

The conference keynote presentation was given by Prof. P. Smith entitled: **Fish vaccines- a short but remarkable journey**. Vaccines for fish have only been available from the beginning of the 80's with only two products registered in 1982 while 25 vaccines were registered in 2004. Some of the vaccines were discussed in particular: a vaccine for tilapia which only afforded a 4% increase in survival but the benefit of vaccination for the farmer was much higher. Similar calculations were presented with a *Vibrio* product for shrimp. Also vaccines can lead to growth penalties due to adhesions occurring when using oil-adjuvanted vaccines. In the future, fish vaccines will beyond doubt benefit from developments taking place in other vaccine fields like the use of improved growth media, the use of attenuated live vaccines although there might be some regulatory issues to be solved especially when applying recombinant (live) vaccines which are considered to be GMO's. In addition, oral vaccines, new adjuvants, DNA vaccination, use of VLP's, the use of RNAi silencing and finally, the use of molecular decoys and molecular sponges might be strategies applied in aquaculture.

Several contributions on **infectious pancreatic necrosis (IPN)** dealt with the importance of viral virulence markers and diagnostic methods but also good protection studies were presented by Ramstad on the beneficial use of vaccines in high and low IPN sensitive salmon strains.

Pancreas disease (PD) got a lot of attention in various contributions. A new challenge model (Hodneland & Knappskog) was presented which could lead to better vaccines against PD. Furthermore diagnostic techniques as well the selection of cell lines for the optimal growth of the PD virus were shown (Graham, Smail). For the first time, evidence was presented for the existence of 6 subtypes of Salmonid Alpha Virus (SAV) based on sequence data comparison of the E2 and nsP3 proteins of SAV isolates from Norway, Ireland, England, Scotland, France, Italy and Spain during 1999-2007. Subtype 1 was only found in Ireland, subtype 2 (causing Sleeping Disease in trout) was found in Scotland, France, Italy and Spain while subtype 3 was only found in Norway. Remarkably, subtype 2 was recently also found in salmon in Scotland. Subtype 4 was found in Ireland and Scotland while subtype 5 was only observed in Scotland. A single but distinct isolate was found in Ireland and was designated as subtype 6. No clear relationship between mortality and viral strain was observed.

Nodaviruses are known to cause disease problems in different Asian marine species as well as sea bass and bream in the Mediterranean, but recently have become an important cause of disease in cod farming in Norway, Scotland and Canada, not only in small (150-460 g), but also in big (1.5 kg) fish. High sea temperature and early maturation and spawning might play a role (Heilberg). Three new genotypes were identified in wild and farmed cod, while nodavirus has been identified in several wild marine species such as pollack, saithe, mackerel and plaice. Their role as potential carriers for the disease is still unknown.

Koi Herpes Virus (KHV) is still recognized as an important disease as demonstrated during a separate workshop organized by Olga Haenen. She also presented a recent survey on the presence of KHV in 26 countries while another 24 countries seem to be free. Diagnosis is done by PCR although test validation by laboratories is needed.



Several contributions dealt with the diagnostic tests for KHV but also that a tk-KHV mutant was still pathogenic for juvenile carp making it not safe enough as a vaccine (Fichtner).

Heart and Skeletal Muscle inflammation (HSMI) incidence seems to have increased in Norway and is suspected in Scotland (identified by histological analysis). Although the identity of the agent is not publicly known, infection studies were performed with tissue culture adapted challenge inoculum whereafter several immune parameters (CD4/CD8, IFN γ , granzyme, IL-10, IL-12) were followed. It seems that the immune response in the heart was mainly of a cytotoxic nature, but that an antibody component is involved as well.

Several contributions dealt with **Flavobacterium**: it was speculated that different colony types of *F. columnare* (Kunttu) and *F. psychrophilum* (Wiklund) might relate to virulence. In addition, farm conditions such as fish density and water temperature seem to have an impact on virulence (Suomalainen).

Francisella sp. was presented as a new disease causing bacteria affecting cod in Norway (Lund, Nordstrøm) but also in Denmark (Dalsgaard). There is a need for an effective vaccine in cod, and preliminary results do indicate this is feasible (Krossøy). In addition *Francisella sp.* are also causing disease problems in tilapia in Costa Rica. In Chile, a new *Vibrio anguillarum* serotype O3 has been isolated causing problems in Atlantic salmon (Avendano-Herrera).

Access to winning posters and the book of abstracts can be gained via the following links
[http://www.eafp.org/Posters/EAFP/Olsen et al.pdf](http://www.eafp.org/Posters/EAFP/Olsen%20et%20al.pdf)
[http://www.eafp.org/Posters/EAFP/Smail et al.pdf](http://www.eafp.org/Posters/EAFP/Smail%20et%20al.pdf)
[http://www.eafp.org/Posters/EAFP/Khalil et al.pdf](http://www.eafp.org/Posters/EAFP/Khalil%20et%20al.pdf)
[http://www.eafp.org/Abstract book final.pdf](http://www.eafp.org/Abstract%20book%20final.pdf)

The first group of aquatic animal health specialists certified in China

Zilong Tan Intervet China

After an intensive 15-day training, 22 trainees from Guangdong Province successfully passed the exams and received a certificate as aquatic animal health specialists on August 15, 2007. The program consisted of both theoretical and hands-on courses related to diseases in fish and shrimp, diagnostic techniques, pharmacology, regulation of medications and disease control. The trainees were professionals specializing in aquaculture and health management. According to Mr. Chen Wen, Director of the Guangdong Provincial Aquatic Diseases Prevention Center, the Province selected Foshan's Shunde District and the city of Zhanjiang as pilot regions. The certification program will enhance the safety of aquatic products for domestic consumption and promote the export business from Guangdong. Guangdong produced 7.24 million metric tons of aquatic products in 2006, with export value totaling US\$1.58 billion. (Source: China Daily 07/08/2007 <http://tinyurl.com/3325ur>). Zilong Tan from Intervet was the guest lecturer who gave an one-day training module on bacterial and viral diseases in fish, diagnostic techniques and the antibiogram test.



2007 Symposium – Chinese Society of Fish Diseases

This symposium was held on August 18th & 19th in Urumqi, XingJiang. Approximately 100 researchers, representing all major research institutes, universities and government agencies, participated in the event. Thirty-five oral presentations were given. A number of emerging diseases were reported, including Enteric Septicaemia of Catfish (ESC) in Channel catfish, Nocardiosis in snakehead, *Streptococcus agalactiae* infection in tilapia and *Spiroplasma* infection in hairy crab.

Zilong Tan from Intervet presented a paper entitled “**The Development of Fish Vaccines for Disease Control in Asia**”, co-authored by Cedric Komar, Neil Wendover and Brian Sheehan of Intervet Norbio Singapore (INS). Besides explaining the needs of vaccines for Asian aquaculture in his talk, Zilong pointed out the importance of having reliable epidemiological data as a foundation for disease research and vaccine development. For example, in Asia *Vibrio* spp. (*V. alginolyticus*, *V. parahaemolyticus*, *V. damsela*, *V. splendidus*, etc.) are the most frequently-reported “disease” in warmwater marine fish. As a result, many researchers are working on these so-called pathogens from DNA sequencing to vaccine research. *Vibrio* spp. are commonly isolated from skin lesion because they are environmental microorganisms and fast growing. Our research findings in Intervet Norbio Singapore and field experience indicate that *Tenacibaculum maritimum*, coupled with skin injury by monogenean infestation and rough handling, causes bacterial skin disease.

Intervet are proud sponsors of the first Fish Health Master class held in Bangkok, Thailand from 12 to 23 November.

The Australian Centre for International Agricultural research (ACIAR) and the Crawford Foundation have come forward to fund a 2-week master class on aquatic animal pathology. The course is coordinated through the University of Murdoch and the department of Fisheries Western Australia. Murdoch University, Department of Fisheries Western Australia, AAHRI in Thailand and NACA are collaborating in implementing the Master class. The course will focus on training candidates in reading and interpretation of slides to understand normal histology, pathological processes, tissue pathology, disease case studies and artefacts. In addition, Dr L. Labrie from Intervet Norbio Singapore has been invited to participate in the Master class and give a presentation on Intervet's research to the participants. More information on the class can be found at www.enaca.org

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Intervet at Asian Pacific Aquaculture 2007.

The Asian Pacific chapter of the World Aquaculture Society held its annual meeting in Hanoi, Vietnam from August 5-8. The conference was attended by Dr Yoshinobu Wada, from Intervet KK, Japan, and Drs Lauke Labrie and Brian Sheehan from Intervet Norbio Singapore. The theme of the conference was “**Prospering from Dynamic Growth**” and a special session devoted to freshwater catfish production in Vietnam discussed the history and current status of *Pangasius* farming, where production is expected to reach 1 million metric tons by the end of 2007.

The session on Aquatic Animal Health was well attended with 28 papers presented by authors from 12 countries worldwide representing various aspects of the aquaculture community from academic researchers to non-governmental organizations and

multinational pharmaceutical companies. Three papers were presented by Intervet. Dr Labrie was invited by the organisers to give an overview of the emerging diseases of fin fish in the South East Asian region (an abstracted version of which is included in this newsletter p 11-12). Dr Sheehan gave an overview of the now well-established benefits of vaccination against *Streptococcus iniae* disease in Asian sea bass using Norvax® Strep Si. Finally, Dr Wada discussed the problem of pasteurellosis, providing details of the epidemiology of this disease in the Asia Pacific region and providing the first public details of Intervet's new bivalent vaccine against pasteurellosis and infections caused by *Lactococcus garvieae*, which is expected to shortly receive market authorization in Japan.

Intervet at the Second International Technical and Trade Conference

“Tilapia 2007” Kuala Lumpur”



Intervet was proud to be a silver sponsor of this conference which was held on 23-25 August in Kuala Lumpur, Malaysia. It attracted nearly 300 delegates representing all sectors of the tilapia industry from 39 countries around the world. Cedric Komar, Neil Wendover and Joseph Ng from Intervet Norbio Singapore attended the conference. The conference was organized by INFOFISH and several other co-organizers including Network of Aquaculture Centres in Asia-Pacific, Worldfish Center and the Ministry of Agriculture & Agro-Based Industry, Malaysia.

A total of 33 papers were presented by internationally renowned speakers in four main sessions which gave a remarkable update of the tilapia industry outlook. Sessions covered global update on world supply, the tilapia production situation in various parts of the world, latest developments in various markets and technological developments in the industry. In this last session, Cedric Komar gave a talk on key infectious diseases in tilapia and the ways to prevent them. An article related to this presentation will be soon published in the 50th edition of Global Aquaculture Advocate to be in press in November 2007. Presentations at the “Tilapia 2007” conference including a full list of the delegates are available on sale in CD format. It is possible to order a copy of the CD at www.infofish.org

SCIENTIFIC SUMMARIES

Alphavirus infections in salmonids – a review

McLoughlin, MF & Graham, DA

Journal of Fish Diseases 30 (9), 511–531, 2007

The first alphavirus to be isolated from fish was recorded in 1995 with the isolation of salmon pancreas disease virus from Atlantic salmon, *Salmo salar* L., in Ireland. Subsequently, the closely related sleeping disease virus was isolated from rainbow trout, *Oncorhynchus mykiss* (Walbaum), in France. More recently Norwegian salmonid alphavirus (SAV) has been isolated from marine phase production of Atlantic salmon and rainbow trout in Norway. These three viruses are closely related and are now considered to represent three subtypes of SAV, a new member of the genus *Alphavirus* within the family *Togaviridae*. SAVs are recognized as serious pathogens of farmed Atlantic salmon and rainbow trout in Europe. This paper aims to draw together both historical and current knowledge of the diseases caused by SAVs, the viruses, their diagnosis and control, and to discuss the differential diagnosis of similar pathologies seen in cardiomyopathy syndrome and heart and skeletal muscle inflammation of Atlantic salmon.

(E-mail: mfmcloughlin@ntlworld.com)



Biophysical properties of salmonid alphaviruses: influence of temperature and pH on virus survival

Graham DA, Staples, C, Wilson, CJ, Jewhurst, H, Cherry, K, Gordon, A & Rowley, HM.
Journal of Fish Diseases 30 (9), 532-544, 2007

A series of laboratory studies were undertaken to investigate the survival of salmonid alphaviruses (SAV) under a range of conditions relevant to waste disposal, persistence and spread in the field, and to laboratory studies and testing. SAV was found to be rapidly inactivated in the presence of high levels of organic matter at 60°C at pH 7.2 and at pH 4 and pH 12 at 4°C, suggesting that composting, ensiling and alkaline hydrolysis would all be effective at inactivating virus in fish waste. Testing was conducted under sterile conditions at 4, 10, 15 and 20°C in sea water, half-strength sea water and fresh (hard) water, both in the absence and the presence of added organic matter. Virus survival was shown to be inversely related to temperature, and to be reduced by the presence of organic matter. Calculated half lives ($t_{1/2}$) under these conditions ranged from 61.0 to 1.5 days. Testing in non-sterile sea water resulted in reduced $t_{1/2}$ values. The half life of SAV in serum was also found to be inversely related to temperature, emphasizing the need for rapid shipment of samples at 4 C to laboratories for virus isolation studies. (E-mail: [david.graham@afbini.gov.uk](mailto: david.graham@afbini.gov.uk))

Pancreas disease in farmed Atlantic salmon, *Salmo salar* L., and rainbow trout, *Oncorhynchus mykiss* (Walbaum), in Norway

Taksdal, T, Olsen, AB, Bjerås, I, Hjortaas, MJ, Dannevig, BH, Graham, DA, McLoughlin MF.

Journal of Fish Diseases 30 (9), 545–558, 2007

The present paper describes, for the first time, clinical signs and pathological findings of pancreas disease (PD) in farmed Atlantic salmon, *Salmo salar* L., and rainbow trout, *Oncorhynchus mykiss* (Walbaum), in sea water in Norway. Similarities and differences with reports of PD from Ireland and Scotland are discussed. Samples of 68 rainbow trout from disease outbreaks on 14 farms and from 155 Atlantic salmon from outbreaks on 20 farms collected from 1996 to 2004 were included in the present study. The histopathological findings of PD in Atlantic salmon and rainbow trout in sea water were similar. Acute PD, characterized by acute necrosis of exocrine pancreatic tissues, was detected in nine Atlantic salmon and three rainbow trout. Salmonid alphavirus (SAV) was identified in acute pancreatic necroses by immunohistochemistry. Most fish showed severe loss of exocrine pancreatic tissue combined with chronic myositis. Myocarditis was often but not consistently found. Kidneys from 40% and 64% of the rainbow trout and Atlantic salmon, respectively, had cells along the sinusoids that were packed with cytoplasmic eosinophilic granules. These cells resembled hypertrophied endothelial cells or elongated mast cell analogues. Histochemical staining properties and electron microscopy of these cells are presented. SAV was identified by RT-PCR and neutralizing antibodies against SAV were detected in blood samples. (E-mail: [torunn.taksdal@vetinst.no](mailto: torunn.taksdal@vetinst.no))

The innate immune response of finfish – A review of current knowledge

Whyte SK.

Fish & Shellfish Immunology 23 (6) 1127-1151, 2007

The decline in the fisheries of traditional marine species has been an incentive for the diversification of today's aquaculture sector into the intensive rearing of many finfish species. The increasing interest in commercial farming of different finfish species is expected to result in similar environmental and husbandry-related problems as have been experienced in the development of the salmonid farming industry. An understanding of the biology of the fish species being cultured, in particular the immune response is important for improved husbandry and health management of the species. The innate



Edward Branson MRCVS, Veterinary Surgeon, RCVS Specialist in Fish Health and Production, Monmouthshire, UK

Edward Branson died suddenly before this book was finished and it is a great sadness to his friends and colleagues that he did not see the completion of a project that was so dear to his heart. Edward was a very active member of the Fish Veterinary Society and it was always his wish that the Society should address all aspects of fish welfare. It was Edward's ambition that the Society holds a wide-ranging workshop on current issues of Fish Welfare and, during his term of office as President, he saw this wish fulfilled. This book is a direct result of that workshop.

immune system of fish has generated increasing interest in recent years and is now thought to be of key importance in primary defence and in driving adaptive immunity. This review focuses on key components (cellular and humoral) of the innate immune responses of different fish species of commercial importance. (E-mail swhyte@upei.ca)

Fish Welfare

New book edited by: Edward Branson Blackwell Publishing, Due January 2008
ISBN: 9781405146296 ISBN10: 140514629X

Fish have the same stress response and powers of nociception as mammals. Their behavioural responses to a variety of situations suggest a considerable ability for higher level neural processing - a level of consciousness equivalent perhaps to that attributed to mammals. Each chapter of this book has been written by specialists in their field. The subject matter is wide ranging and covers in detail concepts of animal welfare in addition to more specific aspects of fish welfare. Philosophical concepts of welfare are discussed along with more practical areas of fish welfare encompassing all husbandry and management activities that have a potential to affect the welfare of the fish in our care. This book is an essential purchase for fish veterinarians, fish farmers, fish biologists and those involved in the aquaculture industry and its regulation.
www.blackwellpublishing.com

Prescription of antimicrobial drugs in Norwegian aquaculture with an emphasis on "new" fish species

Grave, K, Kjerulf Hansen, M, Kruse, H, Bangen M & Bråthen Kristoffersen, A

Preventive Veterinary Medicine (2007) Article in Press,–

The usage of antimicrobial (AM) drugs in farmed fish in Norwegian aquaculture for the period 2000–2005 was investigated by using prescription data. These data were validated against national sales data of AM drugs sold for use in farmed fish and were found to be highly valid. The defined course dose (DCD) was applied as the unit of measurement to correct for the variations in the dosages between different AM drugs. The DCD_{kg} was the amount of an AM drug recommended for the treatment of a 1-kg fish. The calculated number of prescribed DCD_{kg} s is an estimate of the biomass of farmed fish that can be treated with a certain amount AM drug. In the present study, the number of prescriptions issued (i.e., numbers of initiated treatments), weight of active substance prescribed and biomass treated were applied to describe the usage. An increase, although modest, in the AM drug usage in Norwegian aquaculture was observed from 2002 to 2005. This increase was accounted for by new-farmed fish species (other than Atlantic salmon and rainbow trout), especially Atlantic cod. The increased usage of AM drugs in cod in the study period was significantly positively correlated to the biomass produced; even so from 2001 to 2005 the number of prescriptions for cod relative to the produced biomass declined. The AM drug usage in Atlantic halibut as well as the production varied during the study period. For other species such as turbot, coalfish and wolffish the usage of AM drugs was found to be negligible. "Mono-therapy" with quinolones may present a selective pressure in regard to development of quinolone resistance. E-mail: kari.grave@veths.no

Inhibition of sexual maturation in tank reared haddock (*Melanogrammus aeglefinus*) through the use of constant light photoperiods

Davie, A, Mazorra de Quero, C, Bromage, N, Treasurer J and Migaud H.
Aquaculture 270, (1-4), 379-389,2007

The haddock (*Melanogrammus aeglefinus*) is believed to be a potential candidate for aquaculture in the Atlantic coastal countries including the UK, Norway and Canada.



Dr Marian McLoughlin
Editor @ work in Chile

However, under culture conditions, haddock will sexually mature prior to the attainment of a suitable harvest weight. Therefore, a long term tank based experiment was performed where three populations of haddock (hatched spring 2002, approximately 150 fish per population) were exposed to either a simulated natural photoperiod (SNP) or SNP until January or July 2003 and thereafter continuous illumination (Jan LL or July LL respectively) with individual growth rate and maturation status being recorded until July 2004 (27 months post-hatch). While the SNP treated population matured in the spring of 2004 (two years post-hatch) with 88% of the population being observed to release gametes, no mature individuals were observed in either of the LL treated populations and furthermore there was no evidence of gonadal development or elevation in sex steroids (testosterone, estradiol-17 β or calcium). The application of LL appeared to directly stimulate the growth rate of haddock (e.g. 14 to 27% increase in weight thermal growth coefficient) and improve food conversion rates. At the end of the trial there was an approximate 50% increase in wet weight (SNP: 647 \pm 53 g, Jan LL: 982 \pm 34 g and July LL 985 \pm 33 g), however no significant difference in weight in relation to the length of LL exposure was observed. Plasma melatonin analysis revealed that the natural diel rhythm had been inhibited in both LL treated populations. Along with highlighting the similarity in reproductive entrainment between haddock and other gadoids, these results demonstrate how photoperiod manipulation could be used as a management strategy to improve growth performance in farmed haddock stocks. (E-Mail Andrew.davie@stir.ac.uk)

Intervet Aquatic Animal Health Newsletter

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It is our hope and intention that all the information contained in this Newsletter is accurate; however, the Newsletter is intended solely to supply useful information to the aquaculture industry. Thus, Intervet is not liable for any inaccuracies.

Material may be copied providing that the source of information is mentioned

Vaccination experiments in the gadoid haddock, *Melanogrammus aeglefinus* L., against the bacterial pathogen *Vibrio anguillarum*

Corripio-Miyar, Y, Mazorra de Quero, C, Treasurer, JW, Ford, L, Smith, PD and Secombes, CJ

Veterinary Immunology and Immunopathology 118,(1-2), 147-153, 2007

Vibrio anguillarum is one of the primary pathogens responsible for high levels of fish mortality in the aquaculture industry, and among gadoids O2a and b are the most common pathogenic serotypes. In this paper a variety of studies were performed to assess the optimal route by which to challenge haddock against this pathogen, and an optimal regime to vaccinate haddock. The most efficient method to challenge haddock with *V. anguillarum* in this study was immersion in a bath containing 10⁷ cfu/ml, where 60% mortality was seen. Subsequent experiments showed that juvenile haddock could be protected against bacterial challenge with *V. anguillarum*, with a significant reduction in mortalities observed amongst the vaccination treatments when compared to the unvaccinated controls. However, as seen previously in cod studies, vaccination did not induce a specific antibody response. (E-mail: y.corripio@abdn.ac.uk)

Local company contact details: