

INFECTIOUS SALMON ANAEMIA (ISA) IN CHILE - BACKGROUND

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Confirmation of ISA on Chilean Salmon Farms

On July 30, 2007, an article in the media outlet *Aqua.cl* reported the preliminary detection of a variant of Infectious Salmon Anaemia (ISA) on an Atlantic salmon farm in Chiloé, Chile. See the article at: <http://www.aqua.cl/noticias/index.php?doc=18919>.

A 2002 paper by the United States Geological Survey (USGS) describes the known distribution of ISA virus:¹

Infectious Salmon Anaemia Virus (ISAV) is a highly infectious disease of Atlantic salmon (*Salmo salar*) that was first reported within Norwegian aquaculture facilities. The disease has since been described among pre-market Atlantic salmon, *Salmo salar* in Scotland (Bricknell et al. 1998), New Brunswick, Canada (Lovely et al. 1999), the United Kingdom (Rodger et al. 1999), and the Cobscook Bay region of the United States (Bouchard et al. 2001) and from coho salmon (*Oncorhynchus kisutch*) in Chile and the Faroe Islands (Kibenge et al. 2001). The rapid invasion of ISAV into three bays within New Brunswick affecting 21 farms (Bouchard et al. 1998) is one indicator of the severe threat that ISAV represents for Atlantic salmon aquaculture. Furthermore, the annual cost of infectious salmon Anaemia outbreaks among farmed fish in 1999 was reported to be \$11 million (U.S. dollars) in Norway, \$14 million in Canada, and the 1998 – 1999 epidemics in Scotland were valued at a cost of \$32 million (Hastings et al. 1999).

This past July marked the first time ISAV has been identified in Chilean farmed Atlantic salmon.^{2 3} Salmon farms in the Chiloé region comprised approximately 46 percent of Chilean farmed salmon production in 2005.⁴

¹ Cipriano, Rocco C, United States Geological Survey, National Fish Health Research Laboratory, *Infectious Salmon Anaemia Virus*, Fish Disease Leaflet #85, 2002.

² In 2001 a suspected case of ISA in Chilean farmed Chinook salmon was reported in the journal *Diseases of Aquatic Organisms*²

One week following initial reports of possible detection of ISA on one salmon farm site in Chiloe (August 8th), Chile's National Fisheries Service (Sernapesca) confirmed that four farm sites were infected with ISA ("brote") - three owned by Marine Harvest and one by Aguas Claras. At that time, 33 farm sites (include the four farm sites confirmed with ISA) were listed within a 5 km quarantine zone established by Sernapesca.

That same day, August 8th, the World Organisation for Animal Health (OIE) was notified by the Chilean Ministry of Agriculture (Ministerio de Agricultura) of the ISA outbreak in Chile. The OIE report appeared as follows:

Information received on 08/08/2007 from Dr Claudio Ternicier Gonzáles, Jefe División Protección Pecuaria, Servicio Agrícola y Ganadero, Ministerio de Agricultura, Santiago, Chile

Summary

Report type	Immediate notification
Start date	15/06/2007
Date of confirmation of event	25/07/2007
Report date	08/08/2007
Date submitted to OIE	09/08/2007
Reason for notification	Listed disease occurring in new host species
New host species	<ul style="list-style-type: none"> • Salmón del Atlántico (<i>Salmo salar</i>) • Salmón del Atlántico (<i>Salmo salar</i>)
Manifestation of disease	Clinical disease
Causal agent	Infectious salmon anaemia virus, Family Orthomyxoviridae, genus Isavirus
Nature of diagnosis	Clinical, Laboratory (basic), Laboratory (advanced)
Report pertains to	Entire country

New outbreaks

Outbreak 1	Isla Lemuy, Isla Lemuy, Provincia de Chiloe, LOS LAGOS							
Date of start of outbreak	08/08/2007							
Outbreak status	Continuing (or date resolved not submitted)							
Epidemiological unit	Coastal area							
Water type	Salt water							
Population type	Farmed							
Production system	Semi-open							
Affected animals	<i>Species</i>	<i>Morbidity</i>	<i>Mortality</i>	<i>Susceptible</i>	<i>Cases</i>	<i>Deaths</i>	<i>Destroyed</i>	<i>Slaughtered</i>
	Fish	35%	11%	1933000	598384	220000	0	1064606
Summary of outbreaks	Total outbreaks: 1							
Outbreak statistics	<i>Species</i>	<i>Apparent morbidity rate</i>	<i>Apparent mortality rate</i>	<i>Apparent case fatality rate</i>	<i>Proportion susceptible removed*</i>			
	Fish	30.96%	11.38%	36.77%	66.46%			

³ The World Organisation for Animal Health (OIE) Animal Health Information Department notes: "Infectious salmon anaemia has been previously detected in Chile in 1999, though at that time only Coho Salmon (*Oncorhynchus kisutch*) were infected. This time the disease is affecting Atlantic salmon (*Salmo salar*)."

⁴ *IntraFish Media*. July 31, 2007. Disease detected at Marine Harvest farms in Chile, <www.intrafish.com>.

Note that the OIE report states that mortality rates of affected animals were 11% at this time and over one million farmed salmon had already been slaughtered. See the complete OIE report at: http://www.oie.int/wahid-prod/public.php?page=weekly_report_index&admin=0%20%20<http://www.oie.int/wahid-prod/public.php?page=weekly_report_index&admin=0>

The most recent list of centers of ISA outbreak and quarantine posted on Sernapesca's website – dated October 19th – lists six farm sites with confirmed ISA outbreak (“brote”) and three additional farms suspected of having ISA (“sosphecoso”). Below is the list of confirmed and suspected farm sites as it appeared on Sernapesca's website on November 5th:



Listado de Centros de Cultivos en Cuarentena y Sospechosos

Listado de Centros de Cultivos, clasificados como Brotes

- Puchilco – (Marine Harvest) **Brote**
- Cheñiao – (Marine Harvest) **Brote**
- Aldachildo – (Marine Harvest) **Brote**
- Cahueldao – (Aguas Claras) **Brote**
- Curaco de Lin Lin – (Marine Harvest) **Brote**
- San Juan de Chadmo – (Mainstream) **Brote**

Listado de Centros de Cultivos, clasificados como Sospechosos

- Apabón (Marine Harvest) (102714) **Sospechoso**
- Teliupta (Marine Harvest) (103068) **Sospechoso**
- Chalihue (Marine Harvest) (101353) **Sospechoso**

Sernapesca's website no longer allows public access to “Listado de Centros de Cultivos en Cuarentena y Sosphechosos”. Attempts to download the document at: http://www.sernapesca.cl/index.php?option=com_remository&Itemid=246&func=fileinfo&id=1954 now state: “We should have a valid file ID.”

Quarantine zone maps are still available at:

http://www.sernapesca.cl/index.php?option=com_remository&Itemid=246&func=select&id=265

Media reports within the trade publication, IntraFish (www.intrafish.com), suggest that the ISA outbreak has been contained. A November 14th article quotes Chile's Deputy Minister of Fisheries, Jorge Chocair: “We are keeping a close eye on the situation. It would appear we have it under control.”

Chile's Action Plan for ISA

Despite confirmation of the presence of ISA on July 31st, it appears that on July 27th, the Chile's National Fisheries Service's (Sernapesca) issued an official notice of restriction for fish transport ("Dispone restriccion de traslado de peces").⁵

The notice stated [translated from Spanish]:

The **prohibition** of the transport of living salmonids from farm centers of Chiloé Central area, in which there are either fish with clinical symptoms or results of laboratory analysis that suggest the presence of the virus causative of the Infectious Salmon Anaemia, to other farm centers and floating fishpond located outside this area or to a centers located within the area, without evidence of the presence of the disease.

The **warning** to the owners and users of the salmon farm centers of the Chiloé Area in order to adopt the necessary actions to avoid the dissemination of the disease, such as the adoption of appropriate disinfection measures for people, tools, food, waste and vehicles and the application of management and harvesting procedures that avoid the dissemination of the disease.

The August 8th OIE report ⁶ listed the following control measures:

Measures already applied

- Movement control inside the country
- Disinfection of infected premises/establishment(s)
- Quarantine
- Emergency harvest
- Tracing forward
- Tracing back
- Surveillance outside containment and/or buffer zone
- Stamping out
- Surveillance within containment and/or buffer zone
- Zoning
- Vaccination prohibited
- No treatment of affected animals

Measures to be applied

- Control of vectors

⁵ Pure Salmon Campaign obtained a copy of this notice on July 31, 2007 from an academic scientist in Chile.

⁶ http://www.oie.int/wahid-prod/public.php?page=weekly_report_index&admin=0%20%20<http://www.oie.int/wahid-prod/public.php?page=weekly_report_index&admin=0>

The industry trade publication, *IntraFish* (www.intrafish.com) reported in mid-November plans by the Chilean government and industry to reduce disease and/or “biological problems” in Chile. According to a quote attributed to Jorge Chocair, Minister of Fisheries, reported measures will include regulations to “force salmon farmers to lower cage density, as well as make farming facilities more spread out”.^{7 8}

Lack of Disinfection of Wastes

Perhaps one of the most threatening practices in Chilean salmon farming as it relates to ISA and other diseases is the lack of disinfection of wastes from processing facilities. Additionally, boat travel between the farming facilities may also contribute to the risk of disease-transfer in Chile.

The USDA’s 2002 “ISA Program Standards” state, for example:⁹

Infectious Salmon Anaemia virus is transmitted mainly through viral particles shed in fish mucus, feces or wastes, or through direct contact with other infected fish (Rolland and Nylund 1998). Epidemiological investigations indicate that the virus is also spread through untreated waste products and water coming from harvest operations, fish processing plants, and shared equipment and gear that has not been properly disinfected at marine sites (Vagsholm et al. 1994, Jarp and Karlsen 1997, Jarp 1999).

It is our understanding that disinfection of wastes is required in Norway, the rest of Europe, USA and Canada, as a means towards limiting the transfer of disease.

Sea Lice as a Vector for the ISA Virus

Research also points to sea lice as a vector for the ISA virus from infected to susceptible fish.^{10 11 12} The USDA’s “ISA Program Standards” also state that “sea lice of the species *Caligulus elongatus* and *Lepeophtherius salmonis* may also play an important role as vectors that can enhance contagion during epidemics (Nyland et. al. 1994).”

⁷ IntraFish Media. November 15, 2007. *Marine Harvest posts Q3 loss*. Available with subscription: <www.intrafish.com>.

⁸ IntraFish Media. November 15, 2007. *Chile adopts new measures to prevent disease outbreaks*. Available with subscription: <www.intrafish.com>.

⁹ http://www.aphis.usda.gov/animal_health/animal_dis_spec/aquaculture/downloads/isa_standards.pdf

¹⁰ “Infectious Salmon Anaemia” (USDA, January 2002): <http://www.aphis.usda.gov/lpa/pubs/tnisa.pdf>

¹¹ “Infectious Salmon Anaemia Virus” (USGA National Fish Health Research Laboratory, Fish Disease Leaflet No. 85)

¹² “Fish virus detected in Chile raises alarm bells” (The Patagonia Times, 3rd August 2007): <http://www.patagoniatimes.cl/content/view/152/1/>

Government and industry reports have identified serious sea lice outbreaks in Chilean salmon farming operations since this Spring 2007.¹³ In its Q2 report released August 10th, for instance, Mainstream (Cermaq) announced that its profits were down 44 percent from the Q2 2006.¹⁴ In the report, Cermaq explained: “costs of production were higher than in quarter 2 2006 due to sea lice infestation at some sites, lower growth rates and an increase in the cost of feed. And, “Health and sanitary conditions in Chile mean that the volume developments remain uncertain and the cost of production will remain at current levels at least through 2007.”

At the same time, media reports, including statements by INTESAL CEO Adolfo Alvial, for instance, suggested the common sea lice treatments including emamectin benzoate had become less effective at controlling sea lice on Chilean farms due to a build up of resistance to the chemical.¹⁵ ¹⁶ Given the potential for sea lice to serve as a vector of ISA, it is uncertain how the ISA virus may be successfully contained without first gaining control over the sea lice situation in Chile.

Lack of Information and Transparency

In the past year, concerns over the lack of information and transparency surrounding the Chilean salmon farming industry and its impacts have been raised by Chilean conservation organizations, government officials and media alike. The Chilean government and salmon farming industry has still not publicly identified the source of the February 2007 crystal violet contamination in Chilean farmed salmon exported to the UK via Thailand. And, despite numerous information requests related to sea lice outbreaks and drug resistance, antibiotic (fluoroquinolone) use, and various other ecological and health impacts, the Chile’s National Fisheries Service (Sernapesca) has provided no response to questions posed by the Pure Salmon Campaign and its Chilean partners.

Requests for More Information on ISA Go Unanswered

The ISA situation is no different. Despite the small bit of information the Chilean government and industry has provided regarding the ISA outbreak, there are still a lot of unanswered questions.

An August 8th report by the World Organization for Animal Health (OIE) indicated that that the ISA virus was actually present in Chile on June 15th, but it was not confirmed by Chilean authorities until over one month later.¹⁷ And, public reports of ISA did not surface for another several days after this confirmation. The considerable time delay between identification of ISA, confirmation by Chilean authorities and public reporting

¹³ “Sea lice may spark consolidation in Chile - Chile's Region 10 salmon farms are lice heaven” (Intrafish, 9th May 2007): www.intrafish.com

¹⁴ <http://hugin.info/134455/R/1145533/217680.pdf>

¹⁵ Intrafish also reported on 30th April 2007 in an article – “Chilean salmon farming industry on sea lice alert”: www.intrafish.com

¹⁶ “Chilean salmon farming industry on sea lice alert” (Intrafish, 30th April 2007): www.intrafish.com

¹⁷ http://www.oie.int/wahid-prod/public.php?page=weekly_report_index&admin=0

of information by these authorities leads us to question the transparency and oversight of Chilean salmon farming operations.

In August, the Pure Salmon Campaign requested official information on the ISA outbreak from Sernapesca (this included a repeated request from April 2007 regarding the sea lice situation in Chile). Among the questions posed were:

- What was the original source of the ISA virus now identified on Chilean salmon farms?
- What is the estimated risk of ISA spreading to other areas in Region X, where 84 percent of Chilean farmed salmon production is located?
- Is there a possibility of ISA spreading to other salmon farming regions outside Chile via transport of eggs, whole fish or any other means?
- What is the final destination of the slaughtered fish? Is it going to be used for fishmeal or any other uses?
- What additional actions is SERNAPESCA taking to reduce the risk of the spread of ISA? How do you plan to avoid this disease in the future, as the salmon farming industry expands in Regions XI and XII?

Pure Salmon Campaign received no response or data on ISA or sea lice from Sernapesca, in response to our requests. Sernapesca has agreed to meet with the Pure Salmon Campaign on 24th November, however, during which we hope to receive more information on the disease situation.

Chilean Government Official Defends Salmon Farming Industry

In a November 5th article in Chile's El Mercurio newspaper,¹⁸ the Director of Sernapesca (Chile's National Fisheries Service) described criticisms of the salmon farming industry as "absurd." Within the article, Director Inés Montalva, stated [translated to English]:

'I believe that there is an evident campaign that has always persecuted the salmon industry. That they don't comply, that they don't care for the environment, that they are invasive. But it is an industry that requires environmental care for its own benefit. There is a self-limitation.'

The article continues:

According to Montalva, the system has its own limits of making production possible because otherwise, it would damage its own growth possibilities and industry results. Along with this, she pointed out that 'the industry is super-conscientious of its environmental responsibility.'

¹⁸ Neira, Soledad. *El Mercurio*. November 5, 2007. "Fishing Sector: Sernapesca Director: "There is a campaign that persecutes the salmon farming industry." www.emol.com. (Translated by the Pure Salmon Campaign from Spanish into English)

And, regarding industry oversight and inspection:

For Inés Montalva, the oversight method is with information.

‘If you have good information systems set up, you do not need to meddle with the water to know what is happening. Because you know the information about weight, escapes and mortalities,’ she added.

Fidel Espinoza, representative of the Socialist Party (PS) quickly criticized Director Montalva’s statements in *El Mercurio*. In a letter to Chilean President Bachelet reported on in a November 7th *La Nacion* article,¹⁹ Deputy Espinoza wrote [translated to English]: ‘The Director of Sernapesca does not have the morale to continue being in charge.’

Within the letter, Deputy Espinoza further stated that Montalva acted ‘irresponsibly and with absolute ignorance disqualified those who have denounced the inauspicious environmental management of the salmon farming companies.’ And, Mrs. Director has not understood that this is the function of the service that she directs and that it is not a publicity agent for the salmon companies.’

Montalva’s statements also received heavy criticism from Chilean organizations such as Conapach and Pure Salmon Campaign partners - Terram, Ecoceanos and Oceana Chile.

In an unpublished letter to *El Mercurio* in response to Director Montalva’s comments, the Chilean NGO Terram wrote:

It calls to attention Mrs. Montalva’s belief in self-limitation in the salmon industry in environmental protection matters. If this were so, we would not see the impacts that are consensual within the industry such as the impact on sea floors, the damages caused by salmon escapes, the use of excessive antibiotics in Chile or the spread of diseases among farmed and wild species in the Northern hemisphere, among others. The international NGO, WWF, does not coordinate an initiative called the “Salmon Dialogues” without reason. It seeks to generate scientific reports about the different impacts of this activity in order to develop better practices in this production sector. Regarding her comment “the animals in the systems have their own control,” I ask: How does one control an aquatic method in which limits do not exist? Proof that this is so are the growing outbreaks of sea lice and the ISA virus, that in part are spread by the overcrowding of fish in the floating cages, which is frankly, out of control. Another example of the uncontrollability of this activity is the pressure on the fishing resources to produce food for the salmon. The Terram Foundation has calculated that 8.5 kgs of pelagic fish are required to produce one kg of salmon, a figure that has not been able to decrease in discussions with the industry itself!

¹⁹ *La Nacion*. November 7, 2007. “Deputy Espinoza on Sernapesca.” www.lanacion.cl. (Translated by the Pure Salmon Campaign from Spanish into English)

Concerning her comments about oversight, in which she says that it is not necessary to meddle with the water in order to know what is happening on the salmon farm, perhaps if they did, they would see the reality and the extent of the impact on the sea and lake floors, which is not seen in line, like the authority suggests. Under this context, it remains clear that it is necessary to inform the public about how salmon is produced in Chile.

Private Meetings of Chilean Government and Industry

In November (2nd), the Norwegian financial newspaper *Dagens Naeringsliv* reported on a leaked “internal American report” on the ISA crisis in Chile under the headline: “Farms in Chile butchered in internal reports from the American veterinarian authorities.” The article stated [translated from Norwegian]:²⁰

This summer ISA was found in salmon-farms in Chile. Immediately afterwards the American authorities responsible for fish health went to examine the conditions in Chile. The results are depressing for those who thought there would be an easy way out of the problems. The report concludes that readiness was miserable, the possibilities of infections between the facilities are large, and that there are no easy solutions.

Moreover:

Still the big question is how fast and expensive it will be to clean up the problems. The American experts conclude that much has gone wrong in Chile, and that the knowledge and procedures for cleaning up is not in place. ‘Generally speaking the knowledge of biosecurity and the use of this is considerably lacking,’ one of the report states.

The article concluded, “Communication and sharing of disease-information between producers and authorities is more or less non-existent.”

The Pure Salmon Campaign traced the author of this US government report to the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS). During a telephone conversation in early November, Dr. Jill Rolland, an APHIS official, explained to the Pure Salmon Campaign that the report referred to in the *Dagens Naeringsliv* article was an internal travel report written by APHIS staff member Dr. Steve Ellis upon his return from a private ISA meeting in August 2007 (and subsequent personal tour of salmon farms) in Chile. The USDA APHIS office denied Pure Salmon Campaign request for a copy of this “travel report”.

The Pure Salmon Campaign has also been in contact with Professor Fred Kibenge, OIE Expert for Infectious Salmon Anaemia at the Department of Pathology and Microbiology at the Atlantic Veterinary College, University of Prince Edward Island, Canada, who was

²⁰ http://www.dn.no/forsiden/borsMarked/article1156681.ece?jgo=c_current.sv

invited with Dr. Ellis (USDA) to attend the private ISA conference in Chile in July/August 2007. In a November 9th email, Dr. Kibenge informed the Pure Salmon Campaign that this “International Seminar on Infectious Salmon Anaemia” began on August 3, 2007 and was organized by Aquagestion (Fundacion Chile). During an earlier telephone conversation with Dr. Kibenge, he told Pure Salmon Campaign that Sernapesca also attended this conference.

Upcoming Private ISA Meeting – November 19 -20, Puerto Varas, Chile

More recently, we have learned of another upcoming seminar on Infectious Salmon Anaemia (“Taller Técnico sobre ISAv-Chile 2007”) on November 19th and 20th, hosted by the Chilean Government (Sernapesca) and salmon farming industry (Intesal of SalmonChile). We understand that the meeting will take place at Hotel y Cabanas Los Alerces in Puerto Varas.

The Pure Salmon Campaign has sent multiple email requests (November 13th and November 15th) to Sernapesca (Dr. Alicia Gallardo) to attend this ISA workshop. As of November 16th, we have received no response.

On November 13th, the Pure Salmon Campaign’s request for invitation to the ISA seminar to SalmonChile, one of the seminar organizers, was refused. Within the response, SalmonChile director, Rodrigo Infante, explained [translated from Spanish]: “The seminar that we organized for next week is a closed event for our associates and, unfortunately because of this, I cannot extend the invitation to you.”

Sponsors of the government-industry organized seminar include salmon farming and chemical companies such as Marine Harvest, Novartis, Pharmaq, Schering Plough and Bayer.

The organizers have invited speakers from Norway, the Faroes, Canada, Scotland and the United States to attend. To the best of our understanding, attendees will include: Marcos Godoy (Biovac), Joel Leal (AquaBench), Alicia Gallardo (Sernapesca), Knut Falk (NVI), Stian Johnson (Norwegian Food Safety Authority), Graeme Dear (from UK), Debes Christiansen (Faroe Islands), Andrias Petersen (Faroe Islands), Steve Ellis (USDA APHIS) and Fred Kibenge (Canada).

Yet, despite being a government-organized event, NGOs such as Pure Salmon Campaign (including three Chilean conservation organizations) have been refused entry.

Impact on the Profitability of Salmon Farming Companies

The two largest salmon farming companies in the world – Marine Harvest and Cermaq (Mainstream) – have been affected by the ISA outbreak in Chile.

Prior to the ISA outbreak, these companies had already published Q1 and Q2 2007 reports that discuss reduced profits, partially resulting from sea lice outbreaks and other “biological problems.”

In its Q2 report released August 10th²¹, Mainstream (Cermaq) announced that its profits were down 44 percent from the Q2 2006. Within the report, it explained that “lower volumes and higher costs in Chile (as a result of health and sanitation problems) also had a negative effect on EBIT compared to 2006.”

Similarly, on May 16th, Marine Harvest released its Q1 2007 report²², which pointed to ongoing fish health problems in Chile:

The biological challenges are in line with information given earlier and demands industry wide actions to find its solutions. There are no reasons to believe that the biological situation will be significantly improved during 2007, even if lower seawater temperatures during the Chilean winter might reduce the problems somewhat. Significant changes in the industry with respect to farming practices and area management is needed before a permanent solution can be found.

Since the ISA outbreak in Chile, the situation for Chilean salmon farming companies has worsened. According to the trade publication, *IntraFish*, a stock analyst explained: "The reason for Chilean shares plummeting is that the level of costs there are rising in tempo with the biological problems."²³

In its November 2nd Q3 report (www.cermaq.com), Cermaq addresses ISA and continued sea lice problems in Chile. Reported earnings before interest and taxes (EBIT) were NOK 214.9 million (€27.5 million/\$39.7 million), which was a 45 percent decrease compared with the same quarter in 2006. While Cermaq blamed low salmon prices and slow feed growth for decreased earnings, it's CEO admitted: "Production problems in Chile continue to present the biggest challenge to the industry."²⁴

Cermaq's Q3 report stated:

Higher costs in Chile (as a result of health and sanitation problems) and higher feed costs generally also had a negative effect on EBIT compared to the third quarter 2006.

Harvesting delays resulted from increased starvation periods for antibiotic clearance, additional bio security procedures, following the ISA outbreak reported, and bad weather. Compared

²¹ <http://hugin.info/134455/R/1145533/217680.pdf>

²² <http://hugin.info/209/R/1127172/209448.pdf>

²³ *Intrafish*, October 26, 2007, “Salmon stock prices down on Chilean worries,” www.intrafish.com.

²⁴ *Intrafish*, November 2, 2007, “Low salmon prices hit Cermaq Q3 earnings,” www.intrafish.com.

Costs of production were higher than in quarter 3 2006 due to sea lice infestation at some sites, lower growth rates and an increase in the cost of feed. During the quarter Cermaq reported an outbreak of the disease ISA, affecting one site and a limited number of individual fish. The final costs of the outbreak are not yet known but they are now expected to be significantly less than the up to USD 0.5 million originally expected.

Marine Harvest's Q3 results were similarly bleak.²⁵ After the Q3 report was published, shares in Marine Harvest fell 16 percent. Since late August, share prices are down a total of 36 percent.²⁶

Infectious Salmon Anaemia (ISA) (Norwegian - ILA) has been found in Chile, also in sites of Marine Harvest. Production in Chile will be reduced in the short term. Marine Harvest is currently implementing several measures that most likely will contribute to reduced losses and strengthen Marine Harvest Chile's long-term production capacity. Culling of ISA infected fish that will take place in the fourth quarter has been expensed with MNOK 54. Furthermore, the Board of Directors has decided to establish operations in region 11 in 2008

The biological situation in Chile is challenging. ISA is a highly contagious disease that principally affects Atlantic salmon. At present the disease seems contained within a limited area on central Chiloe in region 10. 4 of 46 Marine Harvest sites are affected by ISA in addition to 2 sites already harvested out. Marine Harvest has a high share of its grow out sites in the central Chiloe area (approximately 60%).

Additional ISA Background

The World Organisation for Animal Health (OIE), Chapter 2.1.9 on Infectious Salmon Anaemia states:²⁷

Infectious salmon anaemia (ISA) is a disease of farmed Atlantic salmon (*Salmo salar*) (47) caused by the orthomyxovirus infectious salmon anaemia virus (ISAV) (13, 24, 31). ISA primarily affects fish held in seawater or fish exposed to sea water. However, indications of disease outbreaks in fish held in fresh water have also been reported (37). The disease may appear as a systemic and lethal condition characterised by severe anaemia and haemorrhages in several organs. The most prominent signs observed are pale gills, exophthalmus, distended abdomen, and petechia in the eye chamber; skin haemorrhages in the abdomen and scale oedema may occur.

²⁵ <http://hugin.info/209/R/1168610/229751.pdf>

²⁶ *Intrafish*, November 16, 2007, "Salmon stocks race to the bottom," www.intrafish.com.

²⁷ http://www.oie.int/eng/normes/fmanual/A_00026.htm

Mortality during an outbreak of ISA may vary significantly. Daily mortality in affected net pens may initially range from 0.5 to 1%, but may increase with time. Cumulative mortality ranges from moderate to high and may exceed 90% in severe cases. The disease usually starts in one net pen and it may take many months before the disease develops in neighbouring net pens. Although natural outbreaks of ISA have been recorded in farmed Atlantic salmon only, subclinically infected feral Atlantic salmon, brown trout and sea trout (*S. trutta*) have been identified (41). ISAV has also been detected in two marine species, pollock (*Pollachius virens*) and cod (*Gadus morhua*) (28).

A 2002 paper by Rocco Cipriano, United States Geological Survey (USGS) describes the impacts of the ISA virus:²⁸

Although epizootics of ISAV have been specifically associated with cultured salmon, salmon, Department of Fisheries and Oceans (DFO) - Canada biologists also detected the presence of ISAV among Atlantic salmon populations that are wild or have escaped from aquaculture operations collected at the Magaguadavic River fish trap (Bay of Fundy, New Brunswick). In addition to Atlantic and Chinook salmon, the pathogen infects but has not produced disease in freshwater brown trout, *Salmo trutta* (Nylund et al. 1995); sea trout, *S. trutta* (Nyland and Jakobsen 1995); and rainbow trout, *Onchorhynchus mykiss* (Nyland et al. 1997).

Additionally, regarding the transmission of the disease:

The disease is pronounced in the marine environment, where it is transmitted by cohabitation with infected live salmon or infected biological materials such as animal wastes or discharges from normal culture operations, slaughter facilities (Vagsholm et al. 1994) and contaminated well boats (Shannon 1998; Murray et al. 2002). Infected fish may transmit the disease weeks before they show apparent signs of infection. The virus may spread horizontally, from fish to fish, by shedding of virions from the blood, gut contents, urine, and epidermal mucus of infected salmon (Totland et al. 1996). Moreover, fish that survive epizootics may shed viral particles for more than one month into the surrounding water (Hjeltnes et al. 1994). Blood and mucus contain large amounts of virus and more effectively transmit the disease than feces, plankton and salmon lice (Rolland and Nylund 1998).

Sea lice of the species *Caligulus elongatus* and *Lepeophtherius salmonis* may also play an important role as vectors that can enhance contagion during epidemics (Nyland et al. 1994).

USDA's 2002 "ISA Program Standards" document further describes transmission of the ISA virus:

²⁸ Cipriano, Rocco C, United States Geological Survey, National Fish Health Research Laboratory, *Infectious Salmon Anaemia Virus*, Fish Disease Leaflet #85, 2002.

Infectious Salmon Anaemia virus is transmitted mainly through viral particles shed in fish mucus, feces or wastes, or through direct contact with other infected fish (Rolland and Nylund 1998). Epidemiological investigations indicate that the virus is also spread through untreated waste products and water coming from harvest operations, fish processing plants, and shared equipment and gear that has not been properly disinfected at marine sites (Vagsholm et al. 1994, Jarpe and Karlsen 1997, Jarpe 1999). While there is no validated evidence to indicate that ISA virus is vertically transmitted (i.e. from parent to offspring) (Melville and Griffiths 1999), an investigation of ISA in first-feed Atlantic salmon fry raises the possibility of infection at very early life stages (Nylund et al 1999). ISA can also be transmitted indirectly. Sea lice (*Lepeophtheirus salmonis*) are also potential ISAv pathogen vectors and may increase disease susceptibility through added stress on fish, which may result in substantial infection and mortality (Rolland and Nylund 1998).

For the full USDA “ISA Program Standards” report, go to:

http://www.aphis.usda.gov/animal_health/animal_dis_spec/aquaculture/downloads/isa_standards.pdf

Additional background references

- Royal Society of Edinburgh (2002): THE SCIENTIFIC ISSUES SURROUNDING THE CONTROL OF INFECTIOUS SALMON ANAEMIA (ISA) IN SCOTLAND: <http://www.rse.org.uk/enquiries/isa/report.pdf>
- And, via a Scottish Executive working group report on ISA: <http://www.frs-scotland.gov.uk/Delivery/standaloneCM.aspx?contentid=662>
- ISA is a notifiable disease under UK legislation and a List I disease under European Directive 91/67/EEC. For more information, see: http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31991L0067&model=guichett
- Under EU legislation action must be taken to contain any outbreak, to eradicate sources of infection and to protect other fish farms. See: http://www.frs-scotland.gov.uk/FRS.Web/Delivery/display_standalone.aspx?contentid=817
- A 2001 paper by Frederick S.B. Kibenge et al within *Diseases of Aquatic Organisms* looked at the identification of the ISA virus in Coho salmon in Chile. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=11411649&dopt=Abstract
- <http://www.umaine.edu/livestock/Publications/isa.htm>
- <http://www.lsc.usgs.gov/fhb/leaflets/FHB85.pdf>

- <http://www.cdc.gov/ncidod/eid/vol8no1/01-0144.htm#1>