



Preventive fish health work

Oslo 27.4.2011

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Agenda

- **What is preventive fish health?**
- **How do Mainstream work?**
 1. Non infectious health problems
 - Stress mapping
 2. Infectious health problems
 - ISA in Chile
- **Why this make Mainstream more sustainable?**

A scanning electron micrograph (SEM) showing a variety of microorganisms. In the foreground, there are several large, rod-shaped bacteria with textured surfaces. To their left and right are numerous spherical viruses, some with prominent, radiating spikes. In the background, there are smaller, more complex structures that could be parasites or other types of microorganisms. The overall image is in grayscale, highlighting the intricate details of these tiny life forms.

Pathogen;

- > Microorganism that give a diseases
- > Bacteria, virus, parasite, fungus

What is preventive fish health?

Pathogens in salmon farming

- No pathogens have origin in farming, all comes from “nature”
 - Transmitted; vertical or horizontal

Wild salmon - only a high density during river phase

Farmed salmon - have high density through all life, much higher than wild

- Host density changes the selection pressure of pathogens;

Wild salmon - selection for low aggressive pathogens

Farmed salmon - selection for strong aggressive pathogens

- Pathogens that are harmless in wild fish can make problems in fish farming

What is preventive fish health?

Disease triggers; different types of "stress"

- Salmonides are like other animals – if they are in a good environment and are in good condition they are rarely diseased
- To get a diseased it very often has to be triggered from something in addition to the pathogen
 - In wild: maturation, predators - huge stress
 - In farms: other type of production stress, e.g.
 - Sea lice
 - Unfavourable environmental condition
 - Predators
 - Handling
 - Feeding regimes
 - Other diseases

In farming there are more disease triggers than in "nature"

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What is preventive fish health?

Preventive fish health is based on knowledge

1. **Water quality in tanks;**
 - **Gases, metals, water current, temp., light, pH, pathogens in inlet, organic load etc.**
2. **Water quality in sea;**
 - **Knowledge about local variations, oxygen, light, temperature, salinity, pathogens etc.**
3. **Genetic quality**
 - **"fish health lines"**
4. **Smolt quality**
 - **Pathogen prevalence, size, physiology, morphology, behavior etc**
5. **Nutrition**
 - **Functional feeds, feeding regimes**
6. **Vaccination**
7. **Avoid use of antibiotic**
8. **Area management**
 - **Current, fallowing, generation shifts, parasitic treatments etc**
9. **Reduce stress**
 - **transport, handling, feeding regimes, environment parameters, equipment**
10. **Bio-security**
 - **Disinfection, transport paths**
11. **Traceability of fish and pathogens**
12. **Diagnostic**
13. **Monitoring of known pathogens; foresee and avoid disease out-breaks**

What is preventive fish health?

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13. **Monitoring of known pathogens: foresee and avoid disease out-breaks**

Red text = infectious health problems
Black text = non infectious health problems

- > SYSTEMIZE AND UNDERSTAND THE CONNECTIONS
- > EVERYTHING ARE LINKED WITH EVERYTHING



What is preventive fish health

How do we work with this?

To sum up:

1. Non infectious health problems
 - Optimizing production and welfare
 - FishDiseasGroup with all companies represented
 - "Best practice" and knowledge transfer

2. Infectious health problems
 - Knowledge and monitoring pathogens
 - R&D – 3 Mainstream scientists – office at University of Bergen, support to companies with relevant projects

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Our work – our tools

Non infectious health problems

A example:

- Stress mapping
– a important instrument for measuring fish welfare
- MS Norway



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Our work – our tools

Stress mapping – a important instrument for measuring fish welfare

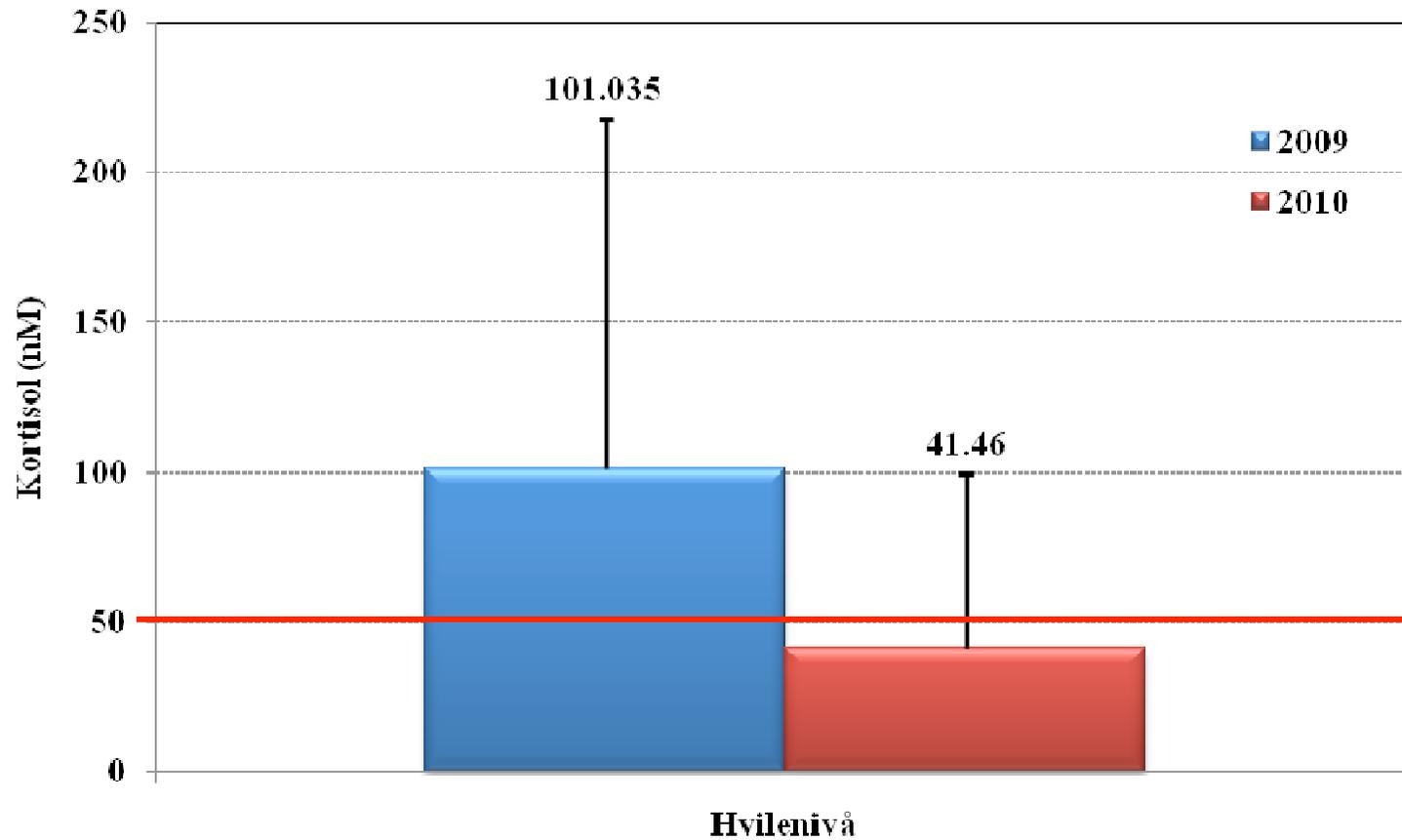
- Production-stress can:
 - Trigger disease out-break
 - Influence the welfare
- Typical bottlenecks;
 - Smoltification
 - Handling
 - Water quality
- Systematic stress hormone monitoring
 - Cortisol in blood
- Aim: Find the underlying causality and do changes
- This mapping have led to changes in:
 - Transport length
 - Pipe size
 - Unload methods
 - Gas levels in water
 - Change of equipment

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Our work – our tools

Result: 60% reduction of production stress

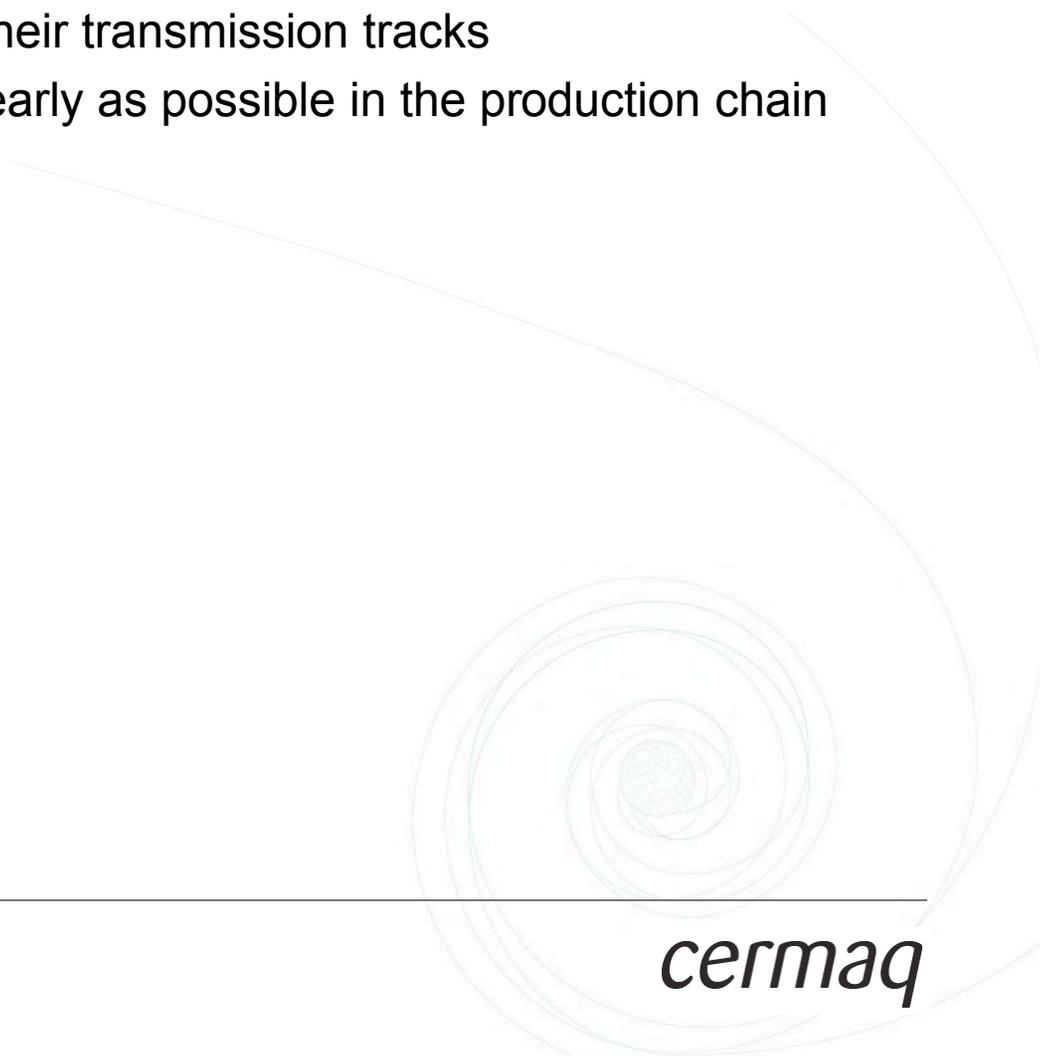


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Our work – our tools

Infectious health problems

- Main activity:
 - Monitoring pathogens and their transmission tracks
 - Eliminate the "problem" as early as possible in the production chain



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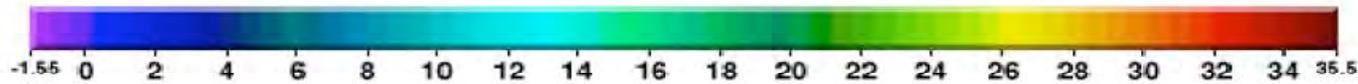
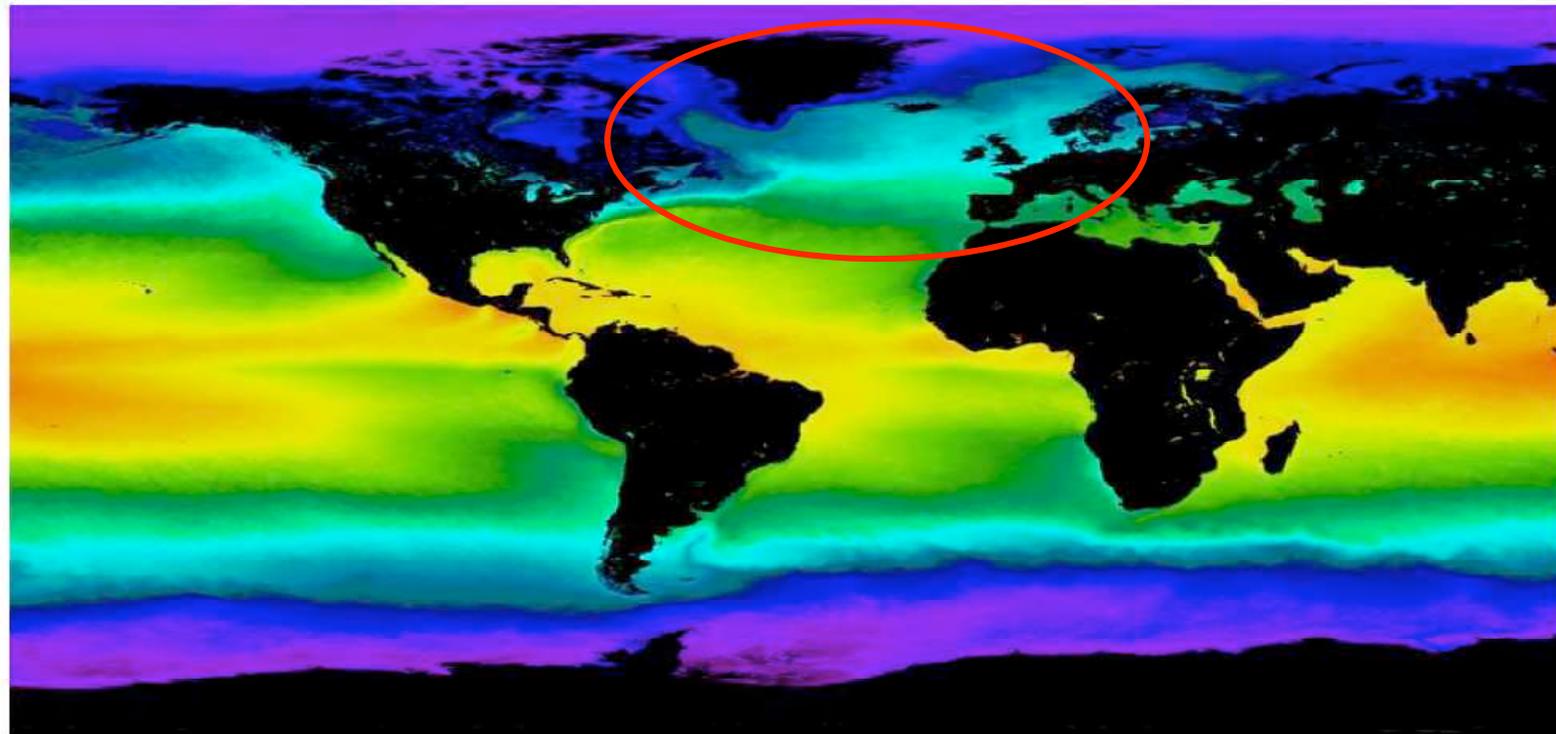
ISA – infectious salmon anemia

An example of a preventive fish health project

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ISA in Chile – a good example

The natural reservoir for ISA virus is the spread of it's host



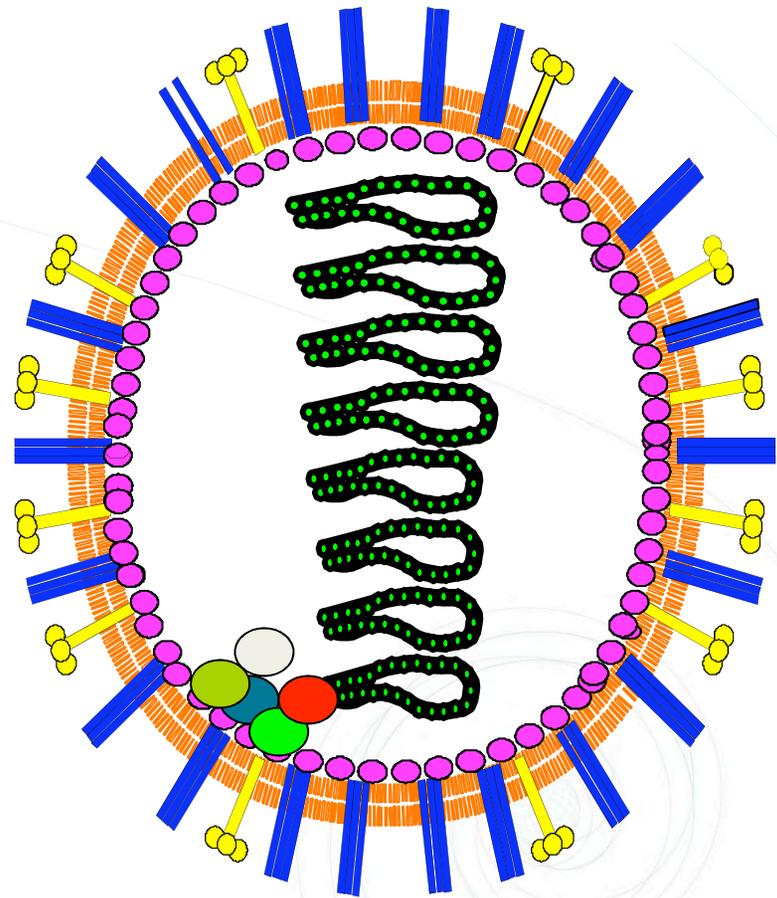
Sea Surface Temperature (°C)



ISA in Chile – a good example

What is ISA-virus?

- Influenza virus family
- Only disease in Atlantic Salmon
- 10 “building blocks”
- 70 nm = 0.0000007 cm
- Two main “types”:
 - Not giving disease – HPR0
 - Giving disease
- Destroy blood cells
- Giving clinical sign like this....



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ISA in Chile – a good example

Clinical signs of ISA



Pale gills

Dark liver

Small bleedings

Liquid

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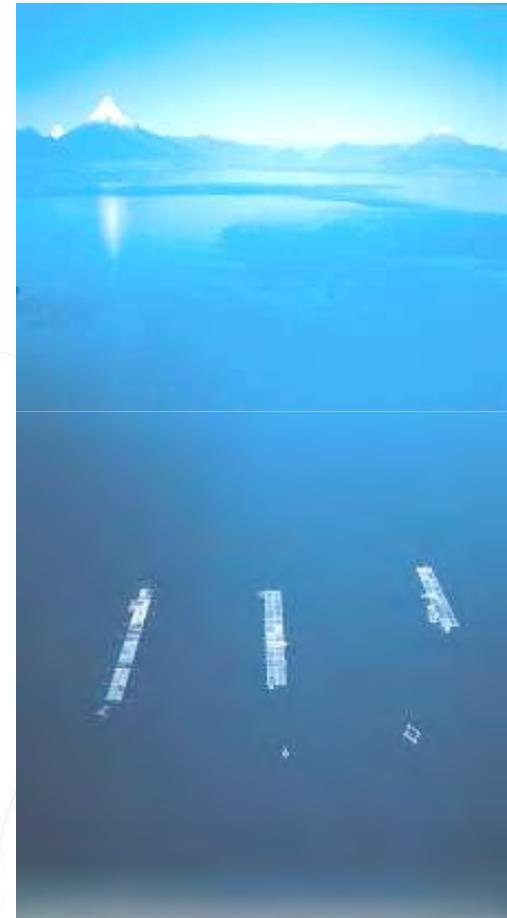
ISA in Chile – a good example

2007 – we had many questions

- How serious is the ISA-situation?
- Where did the virus come from?
- Where did it enter the value chain?
- Prevalence in our fish groups?
- Atlantic? Coho? Trout?
- Diagnosis correct?
- How should we combat it?

- **To be able to combat ISA**
 - Understand transmission routes
 - Define risk factors

- **We needed facts!**



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ISA in Chile – a good example

What we did...

At all Mainstream sites:

1. Systematic screening of all fish groups
2. Family analysis of “our” ISA virus
3. Combine screening data, family analysis with “logistic”:
 - Define transmission routs
 - Define the risk factors

R&D projects:

1. Potential of *Caligus r.* as a vector for the transmission of ISA-virus
2. ISA-virus survival in dead fish; mortality handling
3. ISA-virus survival in sea water ?
4. Vertical transmission – from brood fish to juveniles?

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ISA in Chile – a good example

Screened all our fish groups – made monitoring system



PLAN A

PLAN DE MUESTREO

ISA	Salar			Trucha			Coho		
	Etapa	Peso (grs)	N° muestras (por grupo)	Etapa	Peso (grs)	N° muestras (por grupo)	Etapa	Peso (grs)	N° muestras (por grupo)
Agua Dulce									
	Preselecc	5,0	60						
	Prevacuna	40,0	60	Pretraslado	100,0	60	Pretraslado	100,0	60
	Pretraslado	80,0	60						
Mar		500	30						
		1 000	30		1 500	30		1 500	30
		2 000	30						

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ISA in Chile – a good example

Build a diagnostic lab Real time RT-PCR

5-6 employees



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ISA in Chile – a good example

Systematize screening data – thousands....

Centro	Churrecue	N° Informe	250
Especie	Salar	Fecha muestreo	07-06-2010 08-06-2010 09-06-2010
Tejido	Corazón	Fecha recepción	16-06-2010
Comentarios		Fecha análisis	18-06-2010
Med. Vet. Marcelo Venegas			
Cumplimiento Plan			

Centro	Especie	Grupo	Tipo muestreo	N° Muestra	Tejido	ELa	ISA	Resultado
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	102-1	Corazón	13,92	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	102-2	Corazón	14,23	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	102-3	Corazón	15,39	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	102-4	Corazón	13,83	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	102-5	Corazón	14,82	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	104-1	Corazón	15,13	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	104-2	Corazón	14,35	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	104-3	Corazón	16,61	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	106-1	Corazón	15,72	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	106-2	Corazón	14,42	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	106-3	Corazón	14,52	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	106-4	Corazón	14,51	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	106-5	Corazón	13,13	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	108-1	Corazón	13,12	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	108-2	Corazón	14,23	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	108-3	Corazón	13,62	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	111-1	Corazón	14,84	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	111-2	Corazón	14,60	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	111-3	Corazón	15,47	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Mort. Fresca	112-1	Corazón	13,48	0,00	Negativo
Churrecue	Salar	08SNAGRPHORP61	Al azar	112-2	Corazón	14,67	0,00	Negativo

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ISA in Chile – a good example

Traceability of all generations

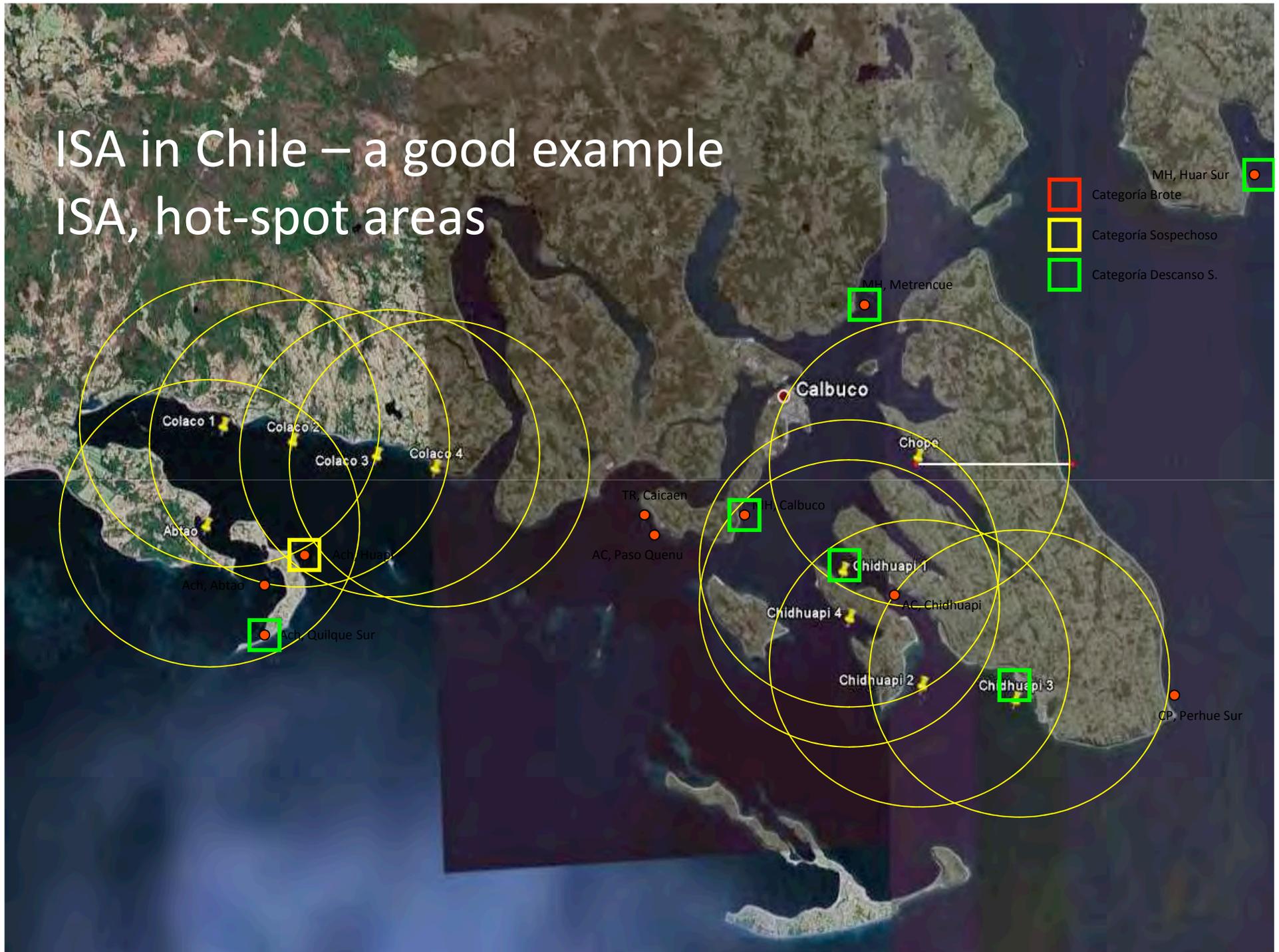
- Traced the history of all fish groups to understand how the virus could enter and moved in our production chain.
- Three generation, three species



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ISA in Chile – a good example

ISA, hot-spot areas





What we have learned....

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ISA in Chile – R&D projects

Potential of *Caligus r.* (Chilean lice) as a vector of ISAv?

Yes.

- ISAv can stay infective for > 48 hours in *Caligus R.* without a fish host



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ISA in Chile – R&D projects

Can salmon dead of ISA contain infective ISA_v?

Yes.

- Heart from a salmon dead of ISA, left to decompose in 5 days can contain infective ISA_v



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ISA in Chile – R&D projects

Can ISA virus survival in natural sea conditions?

No*.

- ISA virus are infective in sterile sea water for > 12 h
- Limited time in natural sea water
- * Project not finish



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Vertical transmission – from brood fish to juveniles?

- Yes

Arch Virol
DOI 10.1007/s00705-008-0251-2

ORIGINAL ARTICLE

ISA virus in Chile: evidence of vertical transmission

Siri Vike · Stian Nylund · Are Nylund

Received: 4 July 2008 / Accepted: 29 October 2008
© Springer-Verlag 2008

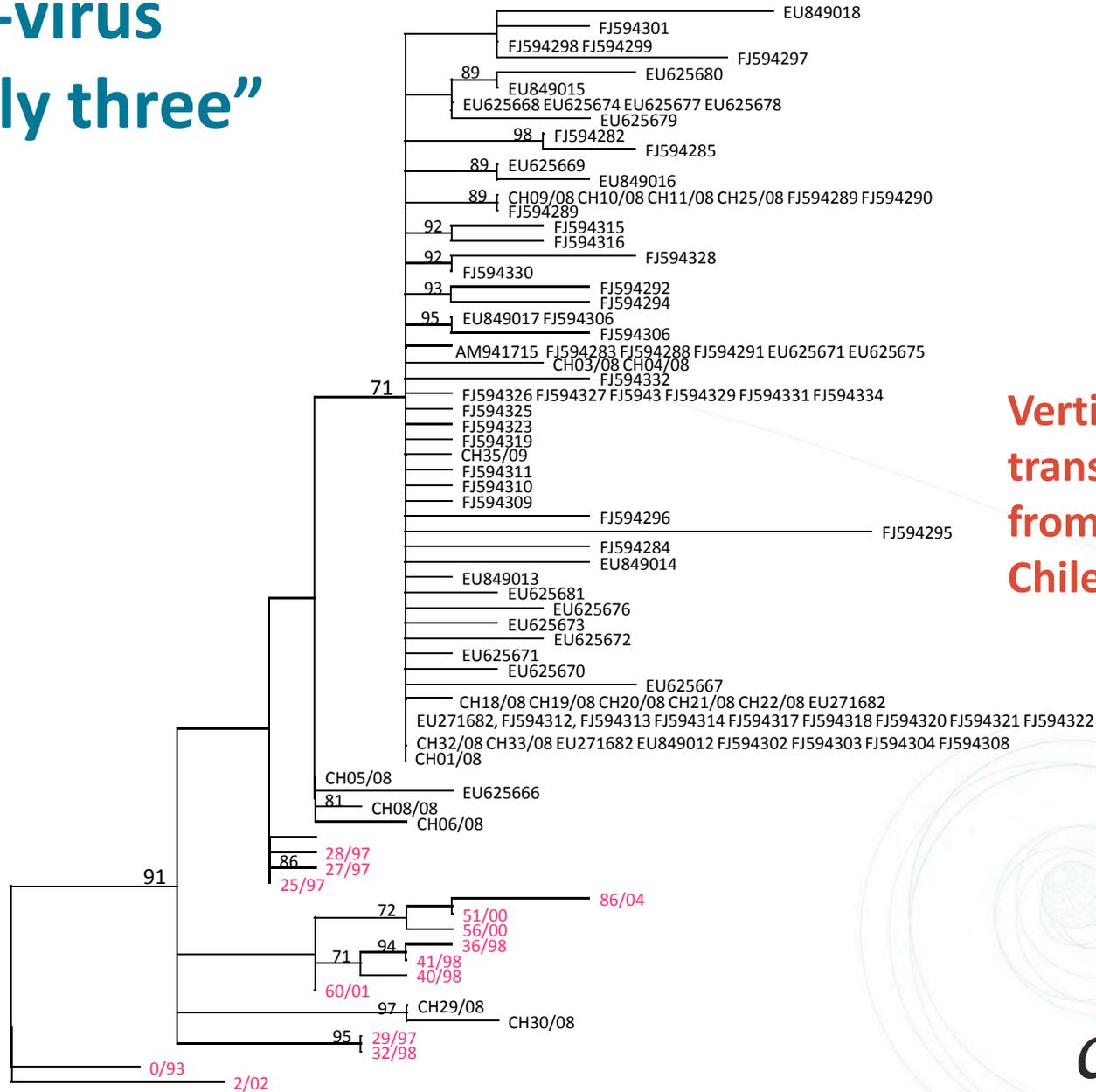
Abstract Infectious salmon anaemia virus (ISAV), genus *Isavirus* (family *Orthomyxoviridae*), is present in all large salmon (*Salmo salar*)-producing countries around the North Atlantic. The target species for this virus are members of the genus *Salmo*, but the virus may also replicate in other salmonids introduced to the North Atlantic (*Oncorhynchus* spp.). Existing ISA virus isolates can be divided into two major genotypes, a North American (NA) and a European (EU) genotype, based on phylogenetic analysis of the genome. The EU genotype can be subdivided into two supported clades based on analysis of segments 1 and 6. Hemagglutination

the possibility of natural reservoirs in this country, and the close relationship between contemporary ISA virus strains from farmed Atlantic salmon in Chile and Norway suggest a recent transmission from Norway to Chile. Norway export large amounts of Atlantic salmon embryos every year to Chile; hence, the best explanation for the Norwegian ISA virus in Chile is transmission via these embryos, i.e. vertical or transgenerational transmission. This supports other studies showing that the ISA virus can be transmitted vertically.

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ISA in Chile – a good example

“ISA-virus family three”



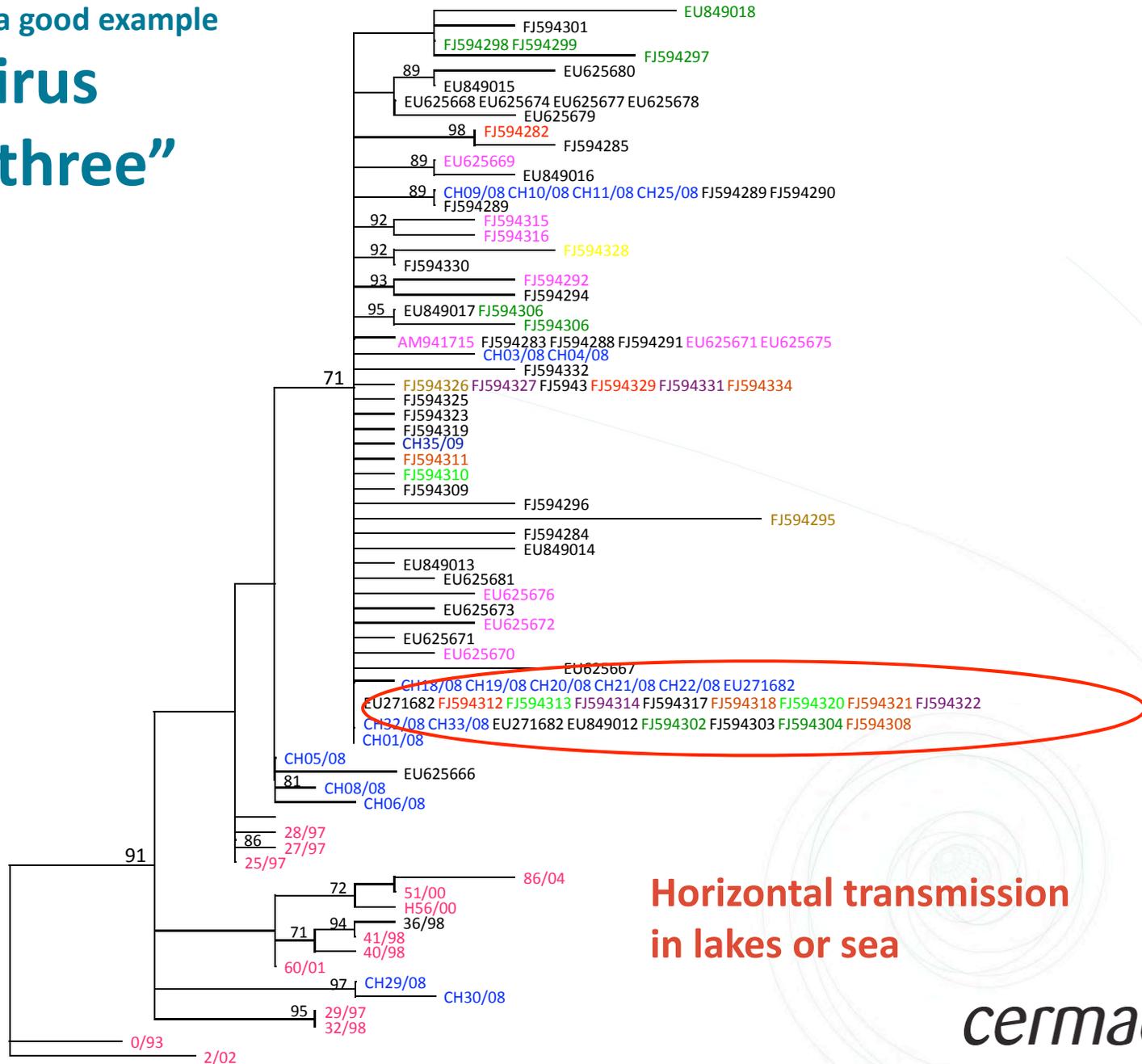
Vertical transmission from Norway to Chile

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0.01

ISA in Chile – a good example

” ISA-virus family three”



Horizontal transmission
in lakes or sea

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0.01

ISA in Chile – a good example

Practical interpretation of all this....

1. Screening and elimination of positive brood fish
2. Possible to transfer ISA-virus free smolt to sea
3. Lakes in Chile are not suited for smolt production
4. ILA-virus do not transmit easily in sea if the salmon are in good condition
5. Single year class – all in all out
6. Synchronized fish lice control
7. Correct mortality handling
8. Avoid ISA triggers: all kind of stress
9. Monitor ISA virus level -> prevalence, foresee out-breaks, eliminate, choose locality

But most of all: It is possible to prevent ISA out-breaks, and if we still get it we can reduce the impact

An underwater scene with fish swimming in clear blue water. A bright light source creates a lens flare effect in the center. A wireframe globe is visible in the background, surrounded by concentric circles.

Sustainable aquaculture

Managing fish health proactively

- Monitor all relevant pathogens
- Avoid stress
- Optimize production conditions

This has made Mainstream more sustainable!

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