



Kvar gøymmer ILA viruset seg

ILA virus reservoar

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ILA virus reservoar

- Biologien til laks og virus
- Spreiing av ILA virus
 - kva seier litteraturen
- ILA Segment 6 Fylogeni
 - Villfisk 2013-16





Biologien til laks

- Spreiing av laksevirus vil måtte reflektere biologien til laks
- Gyting i elvar
 - Høg populasjonstettleik
 - Hyppige interaksjonar
 - Unge individ
- Sjøfasen
 - Låg tettleik





Biologien til laks

- Oppdrett
 - Høg tettleik i sjøfasen
 - Ingen direkte kontakt mellom gytefisk og avkom





Spreiing av eksogene virus

- Horisontalt
- Vektoroverført
 - Mekaniske vektorar
 - Biologiske vektorar
- Vertikalt
 - Via kjønnsprodukt





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Vol. 56: 11–24, 2003

DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org

Published August 15

2003**Emergence and maintenance of infectious salmon anaemia virus (ISAV) in Europe: a new hypothesis**

- ILAV er vanleg i naturlege populasjonar av laks og aure i Europa.
- ILAV vert hovudsakleg spreidd i vassdrag i samband med gyting
- Vill Laksefisk er berar av låg-virulente variantar (HPR0)
- Mutasjonar endrar virulensen
- ILA i oppdrett oppstår etter spreing frå vill laksefisk
 - Mutasjonar anten i villfisk eller i oppdrettsfisk
- Oppdrettsaktivitet viktig for spreing av ILAV
 - Mellom lokalitetar og til villfisk

- Frekvensen av nye primærutbrot i oppdrett reflekterer truleg naturleg variasjon i prevalensen av ILAV hjå vill laksefisk





Internettversjon

Prosjektnummer: 163415/S40
Prosjektperiode: 2005

NFR rapport, 2005

Sluttrapport- Oppdateringsskjema
Sendes ved prosjektslutt til Norges forskningsråd

- Stamfisk
 - 83.8% ILAV-positive
- Egg
 - ILAV i alle egg
 - Både på overflata av og inni egga





Resultat

Internettversjon

Prosjektnummer: 163415/S40
Prosjektperiode: 2005

NFR rapport, 2005

Sluttrapport- Oppdateringsskjema

Sendes ved prosjektslutt til Norges forskningsråd

- Yngel
 - 13,6% ILAV-positive (15/110)
- Parr
 - 1,7% ILAV-positive (2/120)
- Smolt
 - 15,3% ILAV-positive (23/150)
- Postsmolt
 - 16,7% ILAV-positive (25/150)





2005

FELTFORSØK

MED ILA-INFISERT STAMFISK AV LAKS

Er det mulig å overføre ILA-virus via rogn og melke?

oktober 2005



Salm Breed

Veterinærinstituttet
National Veterinary Institute

Mattilsynet

AKVAFORSK
Genetics Center AS**Konklusjoner:**

2. Forsøket viser at det er mulig å finne RNA fra ILA-virus i enkelte rognkorn og yngel etter ILA-syk stamfisk uavhengig av om rognen er desinfisert med buffodine eller ikke.

Analysar frå UiB:

Groups	300-400 day-°C	> 500 day-°C	Locality
UD	20,7 %	11,5 %	ILAB
D	10,4 %	23,0 %	Broodfish company
DD	1,9 %	3,4 %	Broodfish company
	Eyed eggs	Fry	





Arch Virol (2007) 152: 151–179
DOI 10.1007/s00705-006-0825-9
Printed in The Netherlands

2006

**Archives of
Virology**

**Transmission of infectious salmon anaemia virus (ISAV)
in farmed populations of Atlantic salmon (*Salmo salar*)**

A. Nylund, H. Plarre, M. Karlsen, F. Fridell, K. F. Ottem,
A. Bratland, and P. A. Sæther

Conclusions

The geographical pattern of related ISAV isolates presented in this paper shows that the number of isolates in circulation during the last five years is limited, and that these are transported over long distances in connection with egg and smolt transports.

.....the possibility that only avirulent ISAV isolates are vertically transmitted, may explain why ISA most often occurs at marine sites and why no more than about 15 farms get ISA every year in Norway





Dok.nr.06/804



**Opinion of the Panel on Animal Health and Welfare of the Norwegian
Scientific Committee for Food Safety
26.01.07**

**Which risk factors relating to spread of Infectious Salmon Anaemia (ISA)
require development of management strategies?**

II. PROBABILITY OF SPREADING THE DISEASE AS A RESULT OF VERTICAL TRANSMISSION

If the spread of the disease is to be considered a consequence of the vertical transmission of ISA virus then certain central observations should be taken into account. The small number of outbreaks in fresh water stage (0.7 %) and the absence of ISA in some countries that over the years have imported substantial numbers of eggs from Norway suggest that the probability of the disease occurring as a result of vertical transmission of the agent is low.





Research article

Open Access**First detection, isolation and molecular characterization of infectious salmon anaemia virus associated with clinical disease in farmed Atlantic salmon (*Salmo salar*) in Chile**

Marcos G Godoy¹, Alejandra Aedo¹, Molly JT Kibenge², David B Groman³, Carmencita V Yason⁴, Horts Grothusen¹, Angelica Lisperguer⁴, Marlene Calbucura¹, Fernando Avendaño⁵, Marcelo Imilán⁵, Miguel Jarpa⁵ and Frederick SB Kibenge*²

In conclusion, the present work constitutes the first report of a case of ISA in farmed Atlantic salmon in Chile. The clinical signs and lesions are consistent with the classical descriptions of the disease in marine-farmed Atlantic salmon in the Northern hemisphere. The outbreak was caused by ISAV of European genotype (or Genotype I) of HPR 7b but distinct from common European Genotype ISAV isolates.





Arch Virol (2009) 154:1–8
DOI 10.1007/s00705-008-0251-2

2008

ORIGINAL ARTICLE

ISA virus in Chile: evidence of vertical transmission

Siri Vike · Stian Nylund · Are Nylund

-*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.*





Castro-Nallar et al. *BMC Evolutionary Biology* 2011, 11:349
<http://www.biomedcentral.com/1471-2148/11/349>

2011

BMC
Evolutionary Biology

RESEARCH ARTICLE

Open Access

Molecular Phylogenetics and Protein Modeling of Infectious Salmon Anemia Virus (ISAV)

Eduardo Castro-Nallar^{1*}, Marcelo Cortez-San Martín², Carolina Mascayano³, Cristian Molina^{2,3} and Keith A Crandall¹

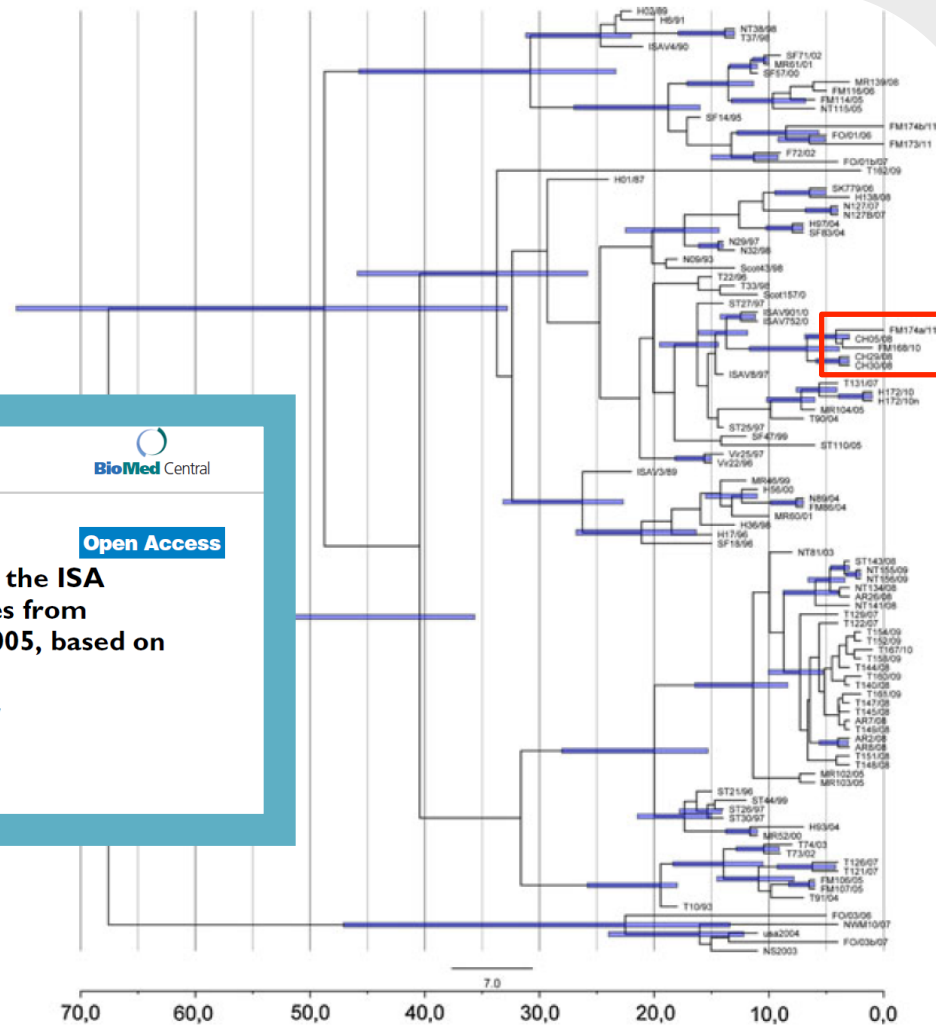
- **Conclusions:** Our results are consistent with the Norwegian origin hypothesis for the Chilean outbreak clade.



Evolution of infectious salmon anaemia virus (ISA virus)

Heidrun Plarre · Are Nylund · Marius Karlsen ·
Øyvind Brevik · Per Anton Sæther ·
Siri Vike

The TMRCA data suggest that the ISA viruses in Chile were transmitted from Norway in the period from 1995 to 2007.



Research

Infectious salmon anaemia virus (ISAV) isolated from the ISA disease outbreaks in Chile diverged from ISAV isolates from Norway around 1996 and was disseminated around 2005, based on surface glycoprotein gene sequences

Frederick SB Kibenge*^{†1}, Marcos G Godoy^{†2}, Yingwei Wang^{†3},
Molly JT Kibenge¹, Valentina Gherardelli², Soledad Mansilla²,
Angelica Lisperger⁴, Miguel Jarpa⁴, Geraldine Larroquete⁴,
Fernando Avendaño⁴, Marcela Lara⁵ and Alicia Gallardo⁵

5 Maximum clade credibility (MCC) tree of the ISA virus HE gene lineage. The tree is scaled to time (horizontal axis), with horizontal bars representing the 95 % HPDs of TMRCA



Modelling the spread of infectious
salmon anaemia among salmon farms
based on seaway distances between
farms and genetic relationships
between infectious salmon
anaemia virus isolates

M. Aldrin^{1,*}, T. M. Lyngstad², A. B. Kristoffersen^{2,3}, B. Storvik¹,
Ø. Borgan⁴ and P. A. Jansen²

- Nearly half of the farms with ISA in the investigated period are predicted to have been infected by an infectious farm in their neighborhood, whereas the remaining half of the infected farms had **unknown sources.**





Vol. 101: 197–206, 2012
doi: 10.3354/dao02520

DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org

Published November 19

2012



Low virulent infectious salmon anaemia virus (ISAV-HPR0) is prevalent and geographically structured in Norwegian salmon farming

Trude M. Lyngstad^{1,*}, Anja B. Kristoffersen^{1,2}, Monika J. Hjortaas¹, Magnus Devold³, Vidar Aspehaug³, Rolf B. Larssen⁴, Peder A. Jansen¹

- ISAV-HPR0 was detected in fish groups both in freshwater and marine environments, and in juveniles, on-grown marine salmon and broodstock salmon





RESEARCH

Open Access

Infectious salmon anaemia virus (ISAV) in Chilean Atlantic salmon (*Salmo salar*) aquaculture: emergence of low pathogenic ISAV-HPR0 and re-emergence of virulent ISAV-HPR Δ : HPR3 and HPR14

Marcos G Godoy^{1,2,3}, Molly JT Kibenge⁴, Rudy Suarez^{1,3}, Eduardo Lazo³, Alejandro Heisinger⁸, Javier Aguinaga³, Diego Bravo³, Julio Mendoza⁷, Katerina O Lleges^{1,3}, Rubén Avendaño-Herrera^{5,6}, Cristian Vera³, Fernando Mardones⁹ and Frederick SB Kibenge^{4*}

- *This is the first report of ISA linked directly to the presence of ISAV-HPR0, and provides strong evidence supporting the contention that ISAV-HPR0 shows a strong relationship to virulent ISAV-HPR Δ viruses and the possibility that it could mutate to virulent ISAV-HPR Δ*





2014

Bona Fide Evidence for Natural Vertical Transmission of Infectious Salmon Anemia Virus in Freshwater Brood Stocks of Farmed Atlantic Salmon (*Salmo salar*) in Southern Chile

Sergio H. Marshall,^{a,b,c,e} Ramón Ramírez,^{a,c,e} Alvaro Labra,^{b,c,d} Marisela Carmona,^{a,b,c,e} Cristián Muñoz^{a,c,e}

- ***The virus recovered from the interior of the eggs was fully infective to a susceptible fish cell line. This is the first robust evidence demonstrating mother-to-offspring vertical transmission.***





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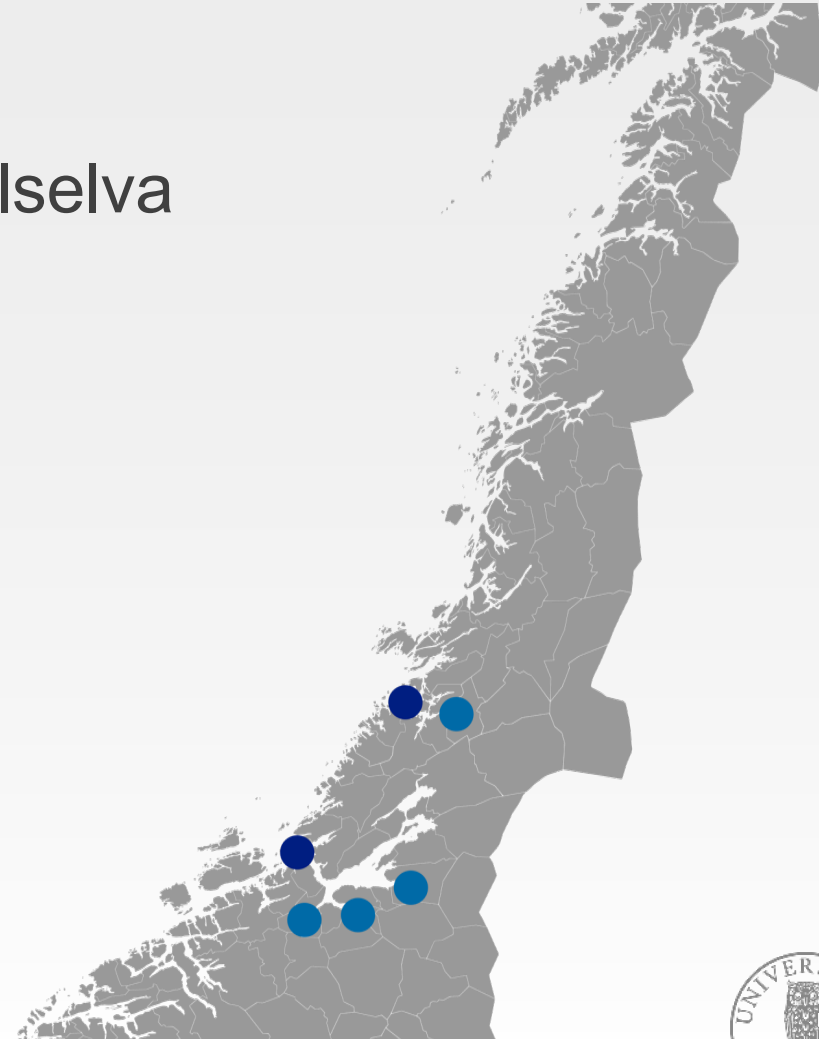
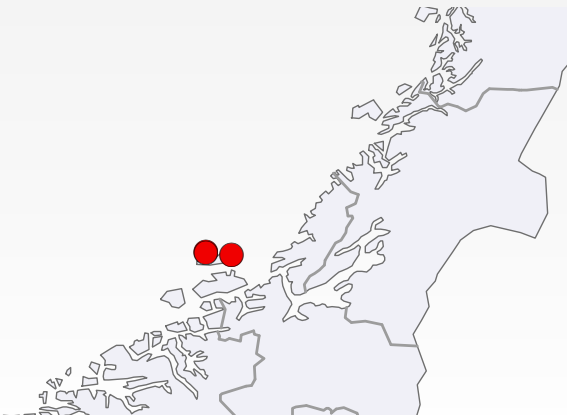
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Materiale

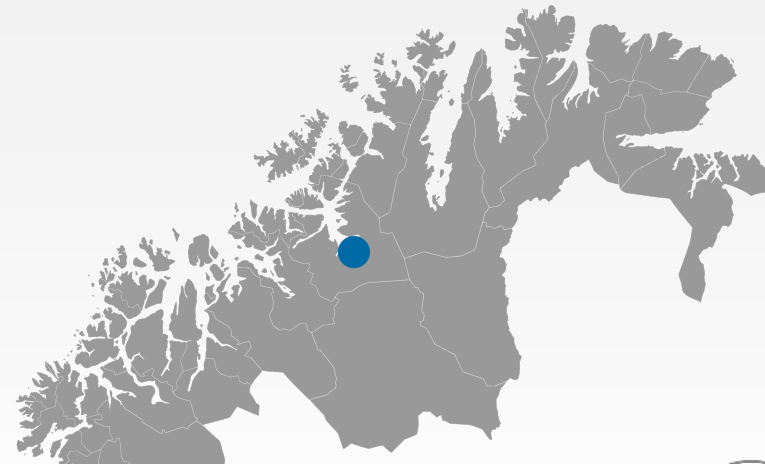
- Orkla, Gaula, Stjørdalselva & Namsen (2013-15)
- Namsfjorden (2015)
- Agdenes (2015-16)





Materiale

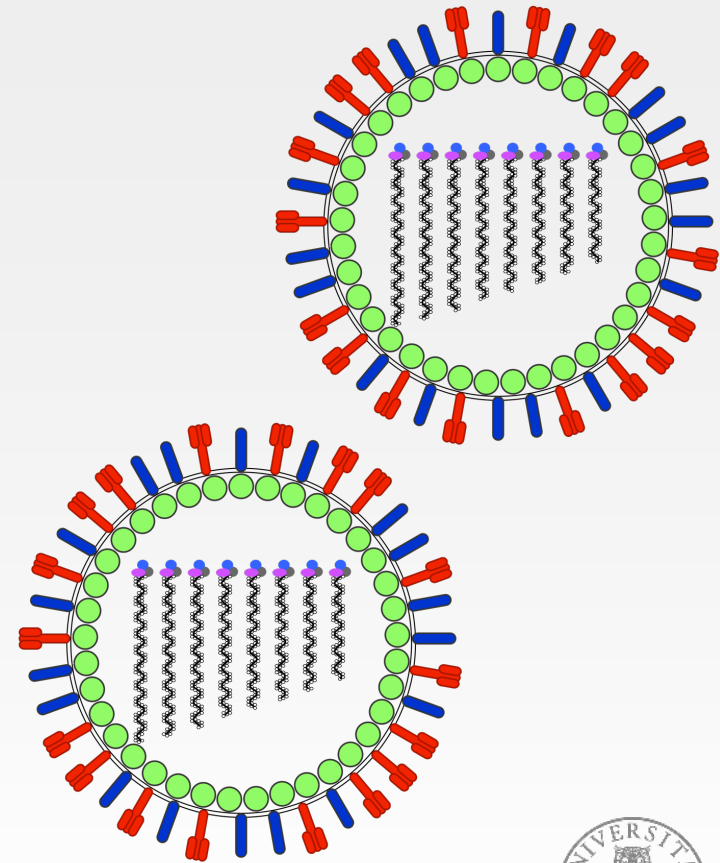
- Altaelva 2016





Metode

- Trizol ekstrahering av RNA
- RT-qPCR
- ILAV-positive:
 - cDNA syntese
 - PCR
 - Evt. Nested PCR
 - Sangersekvensering
 - ML fylogeni





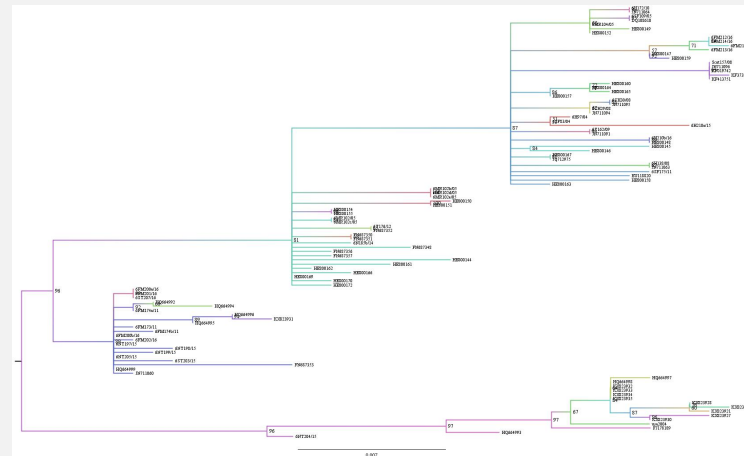
Villaks i Trøndelag, 2013-15

- Prevalens mellom 0 og 21%
- Auke i prevalens i 2015

Lokalitet	2013	2014	2015
Agdenes	-	5/204 – 2,5 %	4/43 – 9,3 %
Orkla	4/70 – 5,7 %	2/70 – 2,9 %	4/72 – 5,6 %
Gaula	3/75 – 4,0 %	1*/149 – 0,7 %	5/46 – 10,9 %
Stjørdal	2/74 - 2,7 %	2/16 – 12,5 %	0/40 – 0,0 %
Namsfjorden	-	-	20/94 – 21,3 %
Namsen	0/121 – 0,0 %	2/95 – 2,1 %	1/49 – 2,0 %
Total / år	2,6 %	2,2 %	9,9 %



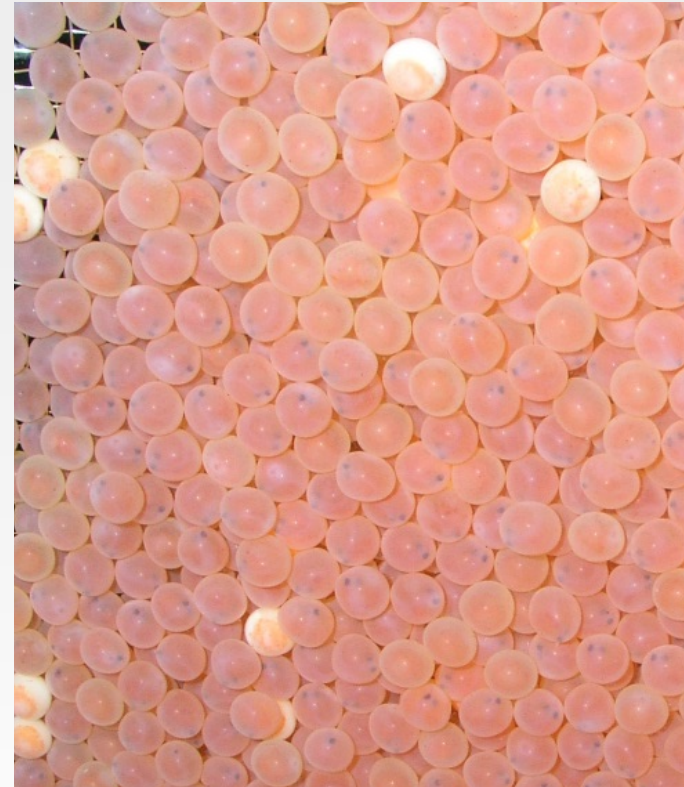
ILAV segment 6, HPR0





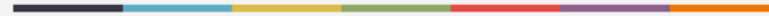
Konklusjon

- Framtidsretta strategiar for næringa må (også) fokusere på spreining av virus via egg/ embyo.





Takk for merksemda!



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