

# **Conditions at the Baltic Sea for Rainbow Trout and for Finnish Aquaculture**

**Kalle Sinisalo - Research Scientist**  
*Natural Resources Institute Finland (Luke)*

**Nordic Salmon workshop**  
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VISION  
A sustainable future  
and well-being from

**RENEWABLE  
NATURAL  
RESOURCES**

MISSION

Through  
research,  
we create  
**VALUE AND  
SOLUTIONS**  
for our customers by  
solving local and global  
challenges

# Luke in brief

# 22

Locations in Finland

HQ in Helsinki

Present in 12 campuses  
with universities, research  
institutes and  
polytechnics



# 129

 M€

Turnover

# 75

 M€

Budget funding

# 54

 M€

External funding\*

# 1274

Employees

14 Management

44 Research professors

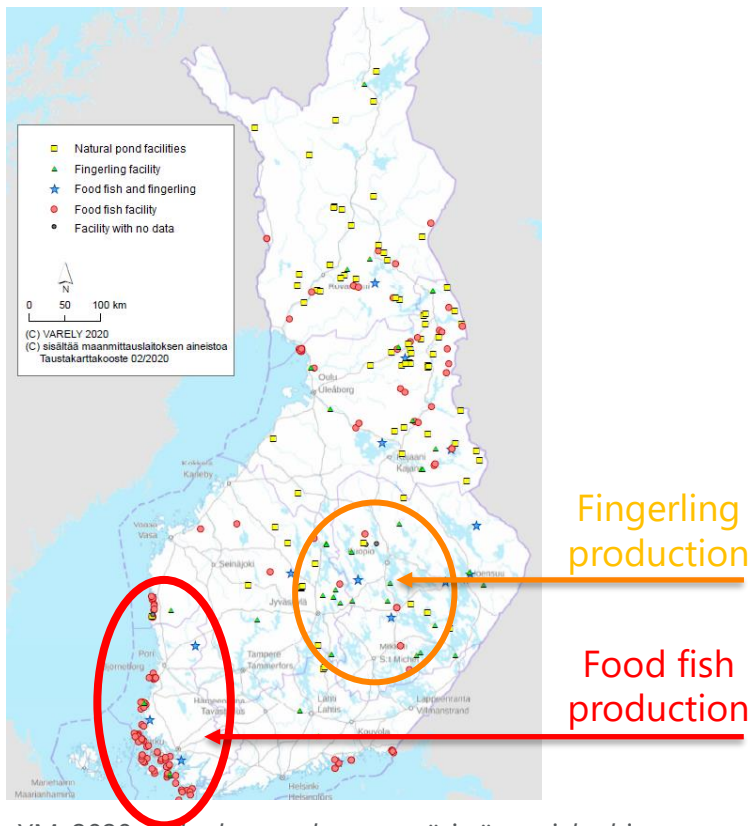
603 Researchers

613 Other specialists

\* Includes profits from co-funded, collaboration and customer-funded projects and other income. Information from the year 2020.

Graphics: Jouni Hyvärinen

# Finnish Aquaculture



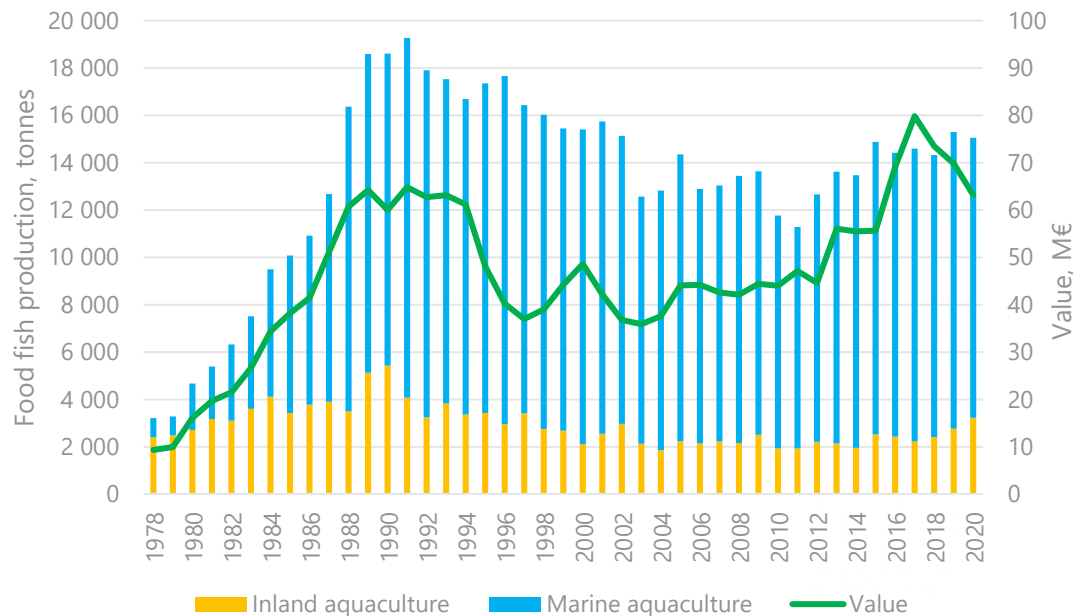
YM. 2020. Kalankasvatuksen ympäristönsuojeluohje.

Max production in 1991

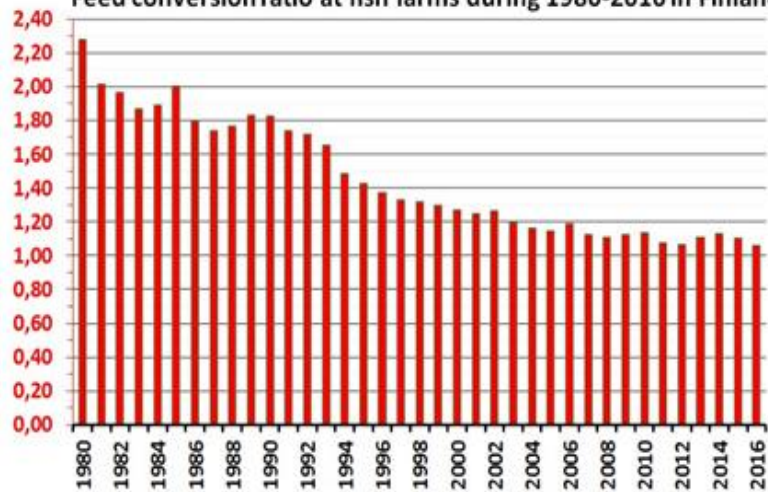
Inland vs. Marine aquaculture

~80 % of production in marine environment

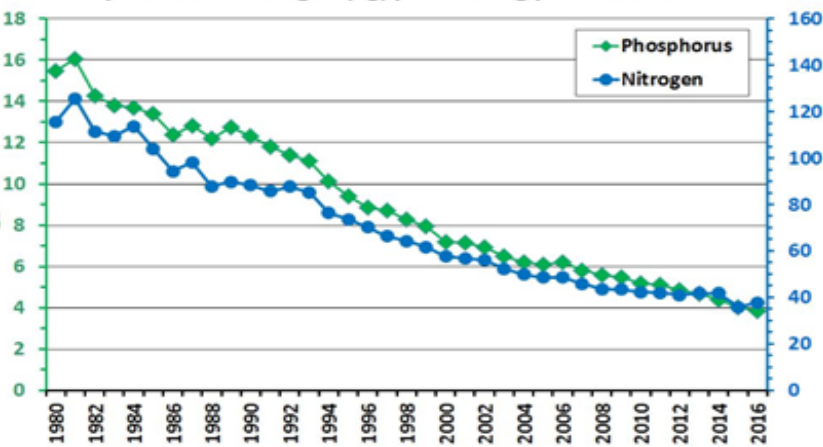
~95 % of production is rainbow trout



Feed conversion ratio at fish farms during 1980-2016 in Finland



Phosphorus and nitrogen (kg) per 1000 kg produced fish



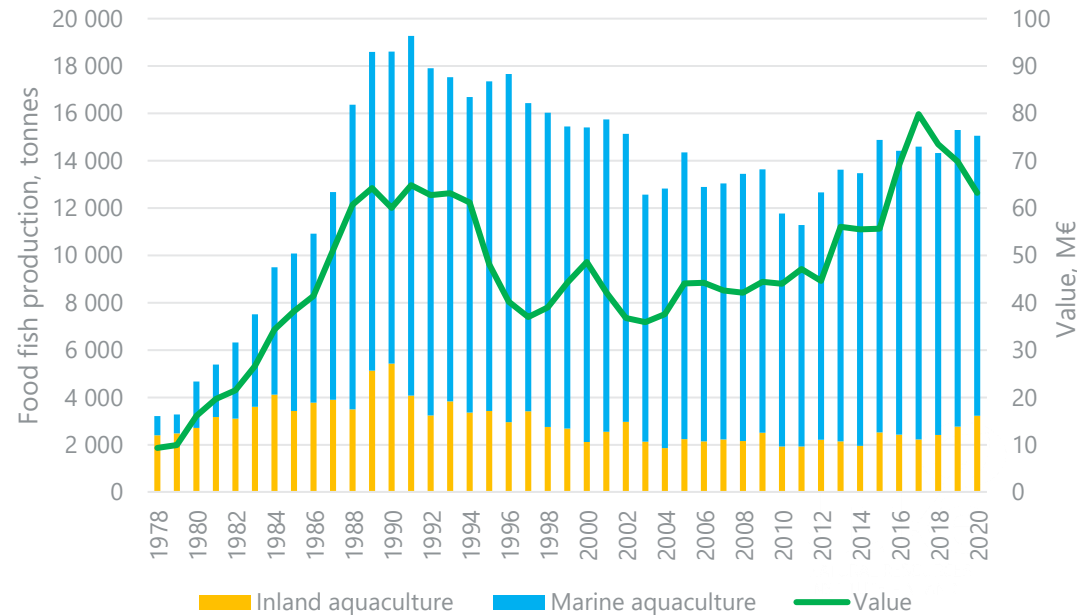
Max production in 1991

Inland vs. Marine aquaculture

~80 % of production in marine environment

~95 % of production is rainbow trout

Over 70 % P and N reduction since early 80s



# Typical rainbow trout production cycle in Finland

## **In-land fingerling production:**

**Egg fertilization:** December

**Vaccination:** April

## **1<sup>st</sup> marine production season:**

**Transport to sea:** May-June, ~20-50 g

**By the end of season around 300-500 g**

## **Over-wintering:**

**Starts around September-October**

**Ends in April-May**

## **2<sup>nd</sup> season: Production**

**to market-size ~2-3 kg**

**April-October**

## **Storage and Slaughter:**

**August-January**

**Transport to market**

# Challenge - Seasonality

Fingerling production

Short annual production period

Fluctuating temperatures

Over-wintering

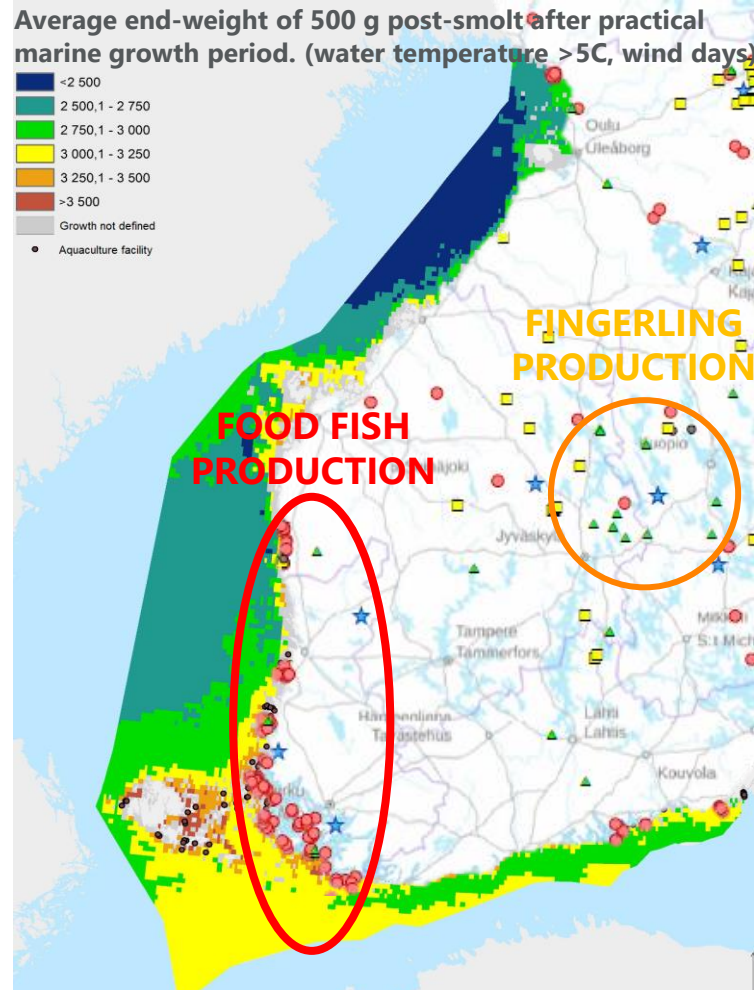
Transportation

Limited areas

Moving ice

Supercooled water

Market peaks





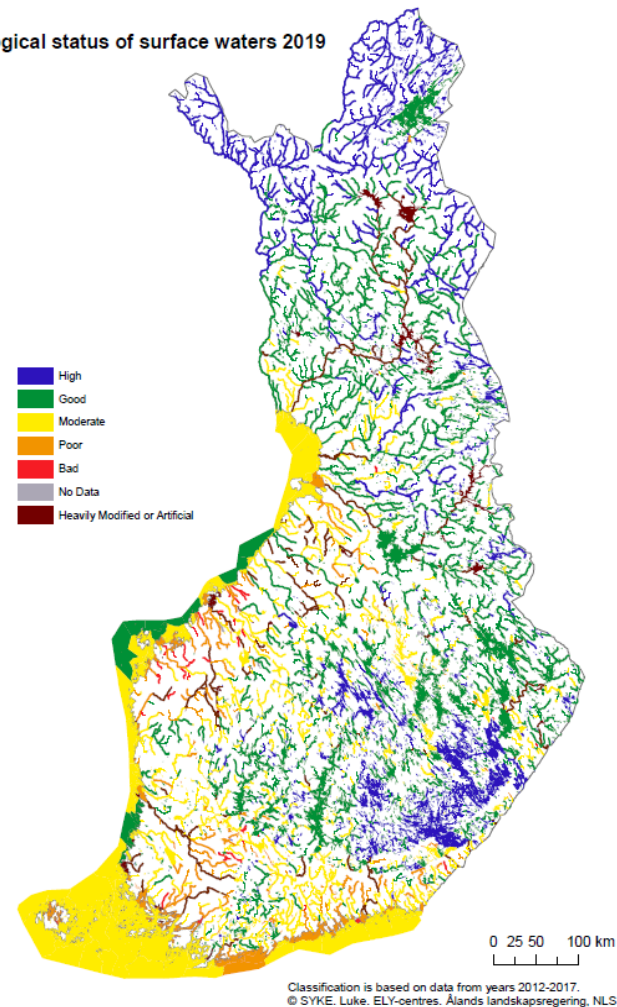
# Challenge – Environmental restrictions (permitting)

Permitting process long and a lot of uncertainty in getting a license

Main restricting parameters for aquaculture license are phosphorous and nitrogen loading from production (eutrophication)

Trend: new licenses mainly to RAS and less sheltered areas (Offshore)

Ecological status of surface waters 2019



Classification is based on data from years 2012-2017.  
© SYKE, Luke, ELY-centres, Ålands landskapsregering, NLS

# Solution – Baltic Sea Fish Feed, recycling the nutrients

## Not so long ago...

Most of the phosphorus and nitrogen load released into the sea by fish farming comes from outside the Baltic Sea due to foreign fishmeal.





# Solution – Baltic Sea Fish Feed, recycling the nutrients

The mass balance of nutrients in the Baltic Sea would remain unchanged.

The amount of nutrients in fish feed raw material would correspond to the nutrient emission from aquaculture.

Parameter		Unit
Phosphorus load from fish farming	4.2	Kg/tonne edible production
Nitrogen load from fish farming	39.0	Kg/tonne edible production
Phosphorus in Baltic herring	4.3	Kg/tonne edible production
Nitrogen in Baltic herring	23.3	Kg/tonne edible production
Feed conversation rate (FCR)	1.15	Fish feed kg/kg fish
Fish meal in fish feed	17 or 29	% of fish feed
Fish meal from Baltic herring	20	% of kg Baltic herring

[https://curis.ku.dk/portal/files/225000379/IFRO\\_Report\\_287.pdf](https://curis.ku.dk/portal/files/225000379/IFRO_Report_287.pdf)

## Now/In the future

Herring used for making fishmeal removes equal amount or even more phosphorous (and nitrogen) than fish farming generates.



<https://www.slideshare.net/RaisioOyj/raisio-groups-interim-report-january-march-2016>

# Baltic Blend feed innovation

Since 2016:  
Fishmeal factory  
in Kasnäs

Fishmeal and  
oil made of  
herring and  
sprat

Raisioaqua  
manufactures  
feeds  
**BALTIC  
BLEND**

Feeding to farm  
the fish for  
human  
consumption

Fresh fish for  
consumers  
**BENELLA**

Baltic  
herring/sprat as  
raw material for  
fish meal and  
oil

Phosphorus and  
nitrogen  
removed from  
the sea

Phosphorus  
and nitrogen  
removed with  
farmed fish

Baltic herring and sprat  
eat zooplankton

Zooplankton eat  
phytoplankton

Phytoplankton bind  
phosphorus released  
from farming

Small amount of phosphorus and  
nitrogen returned to the sea

# Solution – Baltic Sea Fish Feed, recycling the nutrients

Recycling fish feed concept has not been totally accepted

No legal status in permitting process:

- Use of compensatory tools are not directly mentioned in legislation and not necessarily taken into account in licensing procedure
- No strong incentive to use Baltic Sea Fish Feed (BSFF)



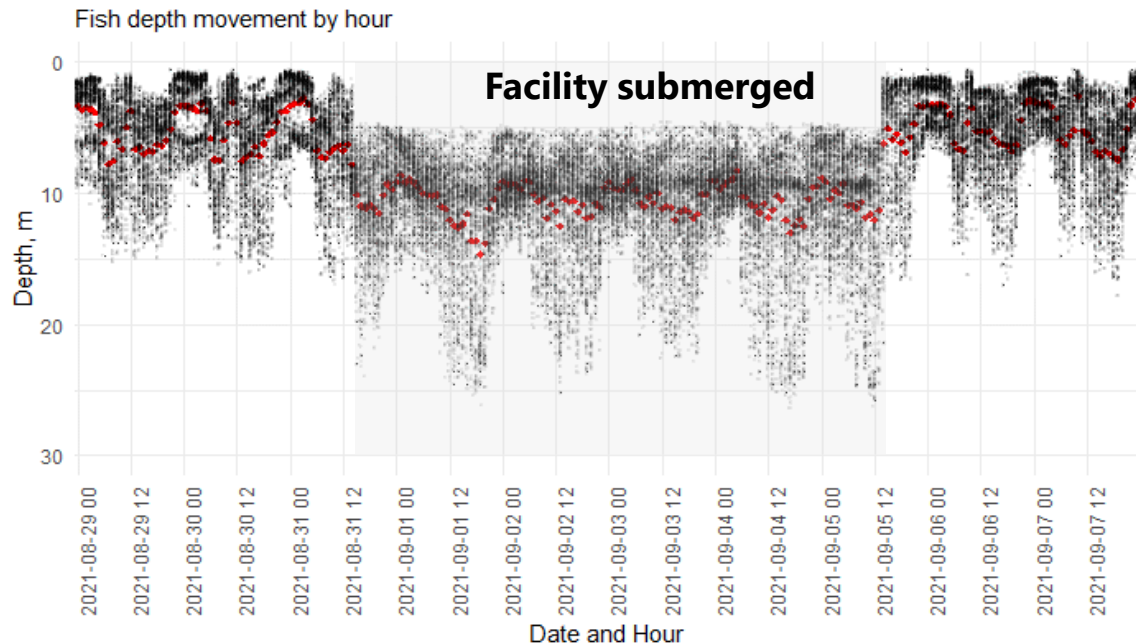
# On-going research: Offshore farming

Production (and winter storage)  
in more exposed areas

Working with submersible net  
cage since August 2020

Last winter rainbow trout  
submerged with poor results

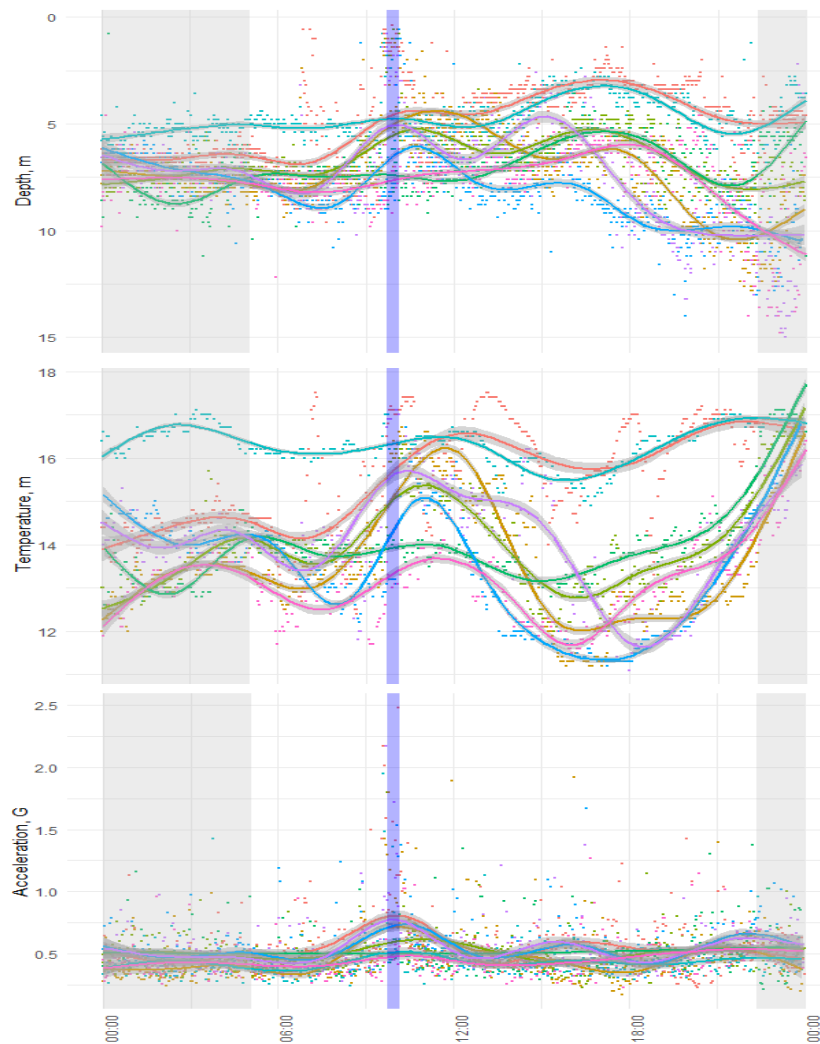
This year telemetry system  
from Thelma Biotel



Korra research site. Daterange 2021-08-29 – 2021-09-07



# On-going research Offshore farming



a)

# On-going research: RAS smolt production (rainbow trout)

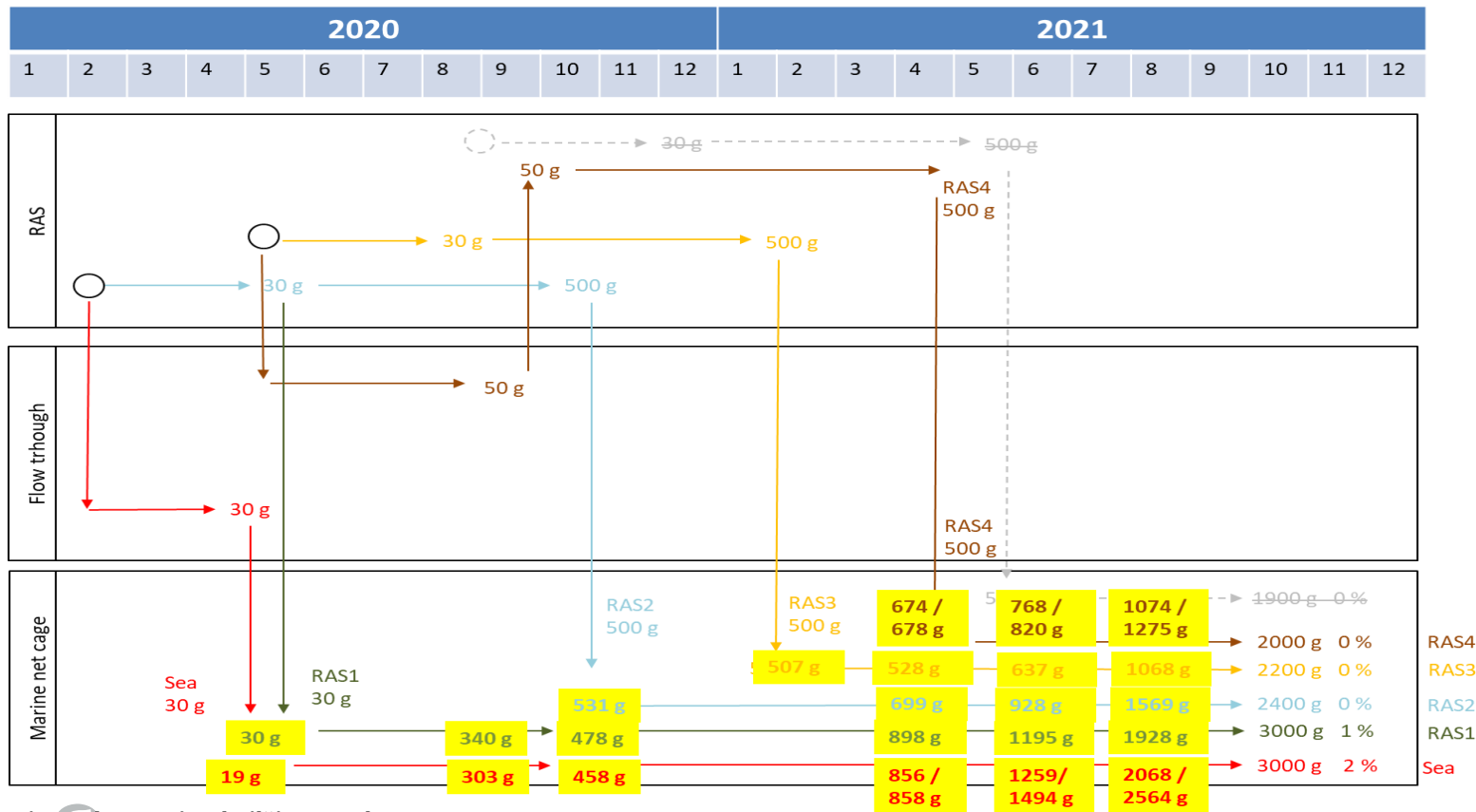


Figure by Harri Vehviläinen, Luke



# On-going research: Partial RAS - PRAS



Plug-and-play farm solution using partial RAS (PRAS) for reliable and profitable fish farming.

Only water connections and electricity needed  
Luke's modular shipping container concept uses mixed-cell raceway principle  
Even with no biofilters a reduced nutrient loading  
Prototype is being tested in Laukaa, Finland.

# Thank you!