

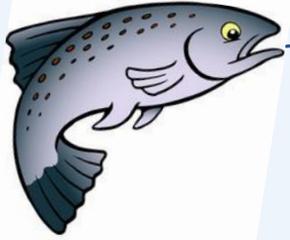
A salmon's view of climate change



Amanda Vang

Head of Department, Biotechnology

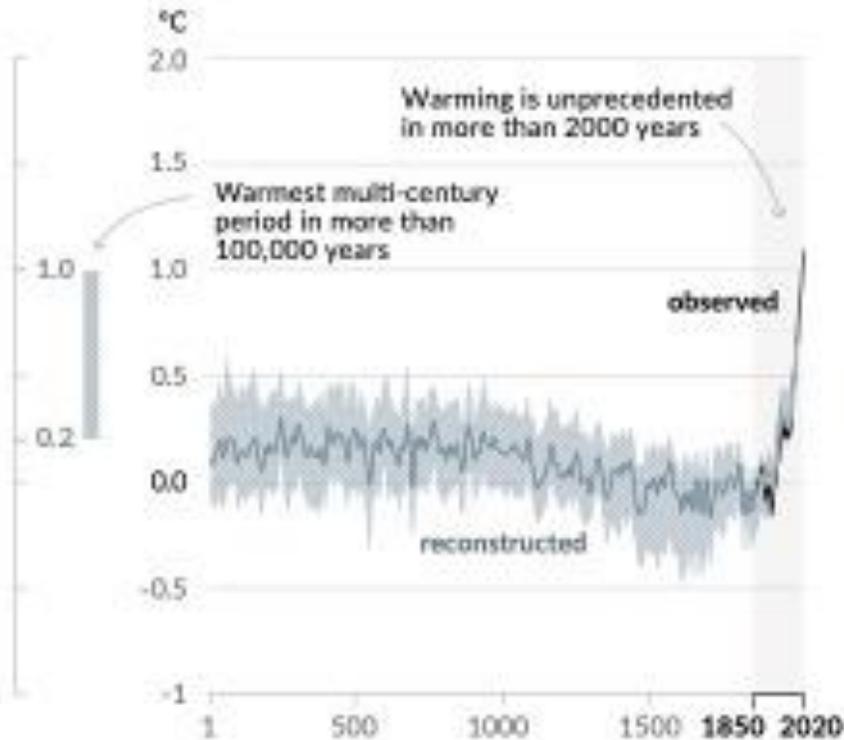
Climate change is not fake news



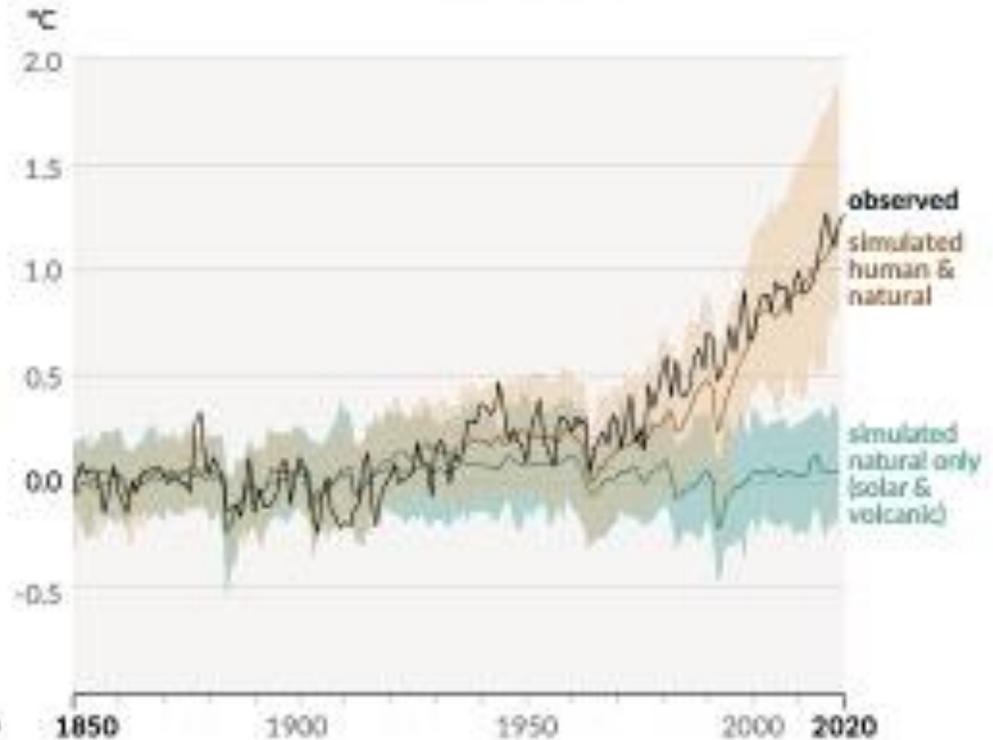
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850-1900

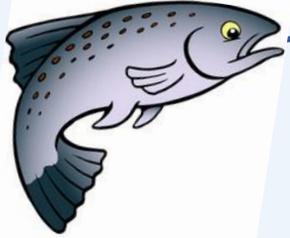
a) Change in global surface temperature (decadal average) as reconstructed (1-2000) and observed (1850-2020)



b) Change in global surface temperature (annual average) as observed and simulated using human & natural and only natural factors (both 1850-2020)

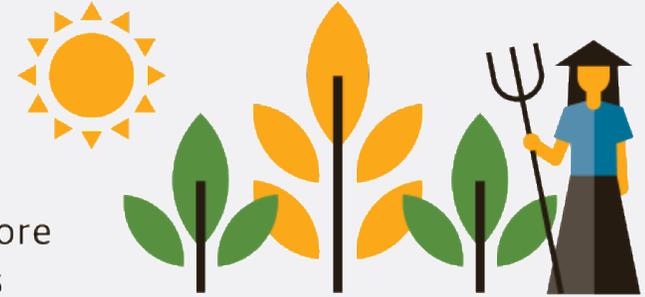


Land-based farming may not produce enough food in the future. Maybe I can help?

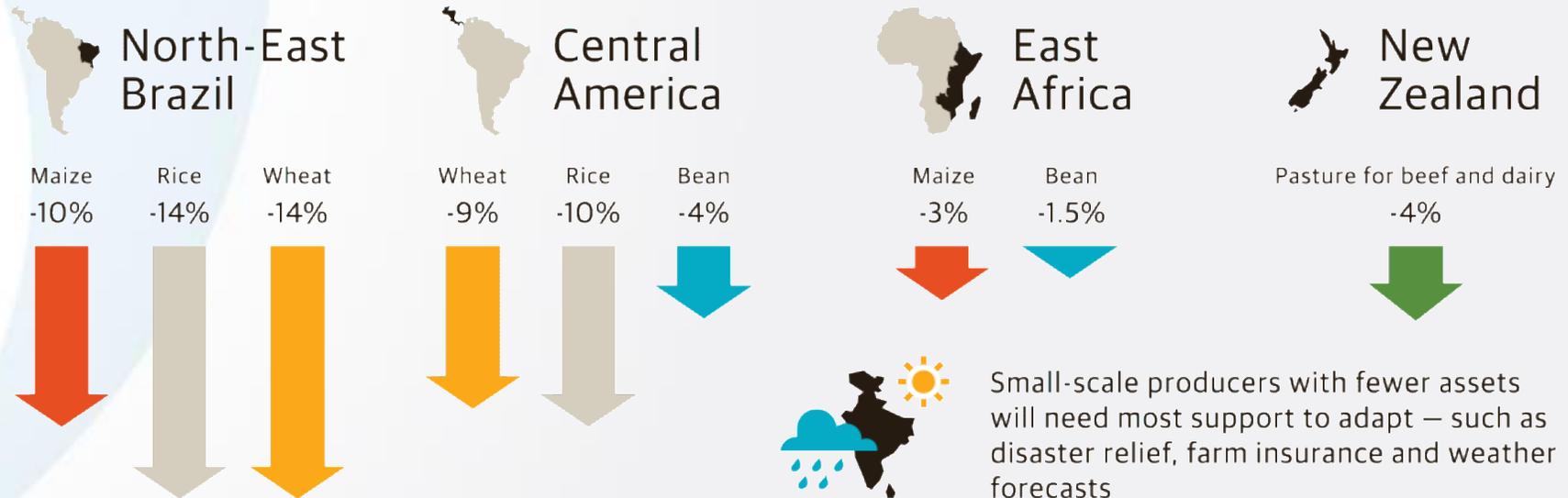


The future of food and farming: 2030s

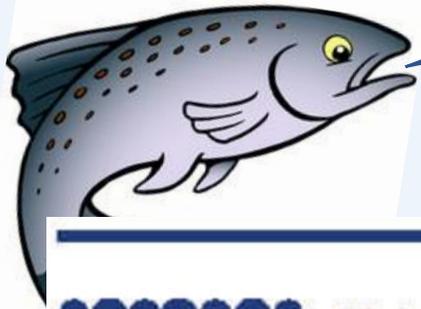
In the 2030s, climate change will affect food and farming more strongly, particularly small-scale producers in poor countries



Crop and pasture yields are likely to decline in many places



It's my time to shine!



Global population set to hit over

9 BILLION *by* **2050**¹



Farmed fish is the most resource-efficient animal protein on the planet⁵



Feed Conversion Ratio⁶

1.2-1.5*

1.7-2

2.7-5

6-10

Fresh Water⁶

1
Gallon

2,000
Gallons

3,500
Gallons

2,500
Gallons

Carbon Footprint⁶

(t of CO₂-equivalent per t of edible protein)

9.8*

42.3

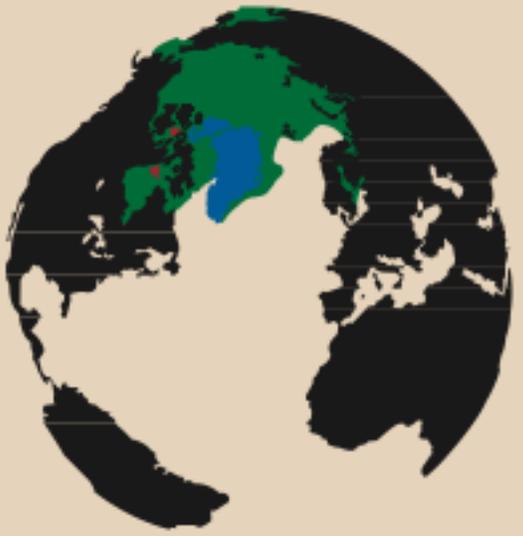
57.6

337.2

Aquaculture could feed the world and protect the planet.

“Aquaculture is inherently a resource-efficient means of producing food. Marine aquaculture requires no land and minimal fresh water.”

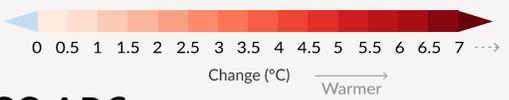
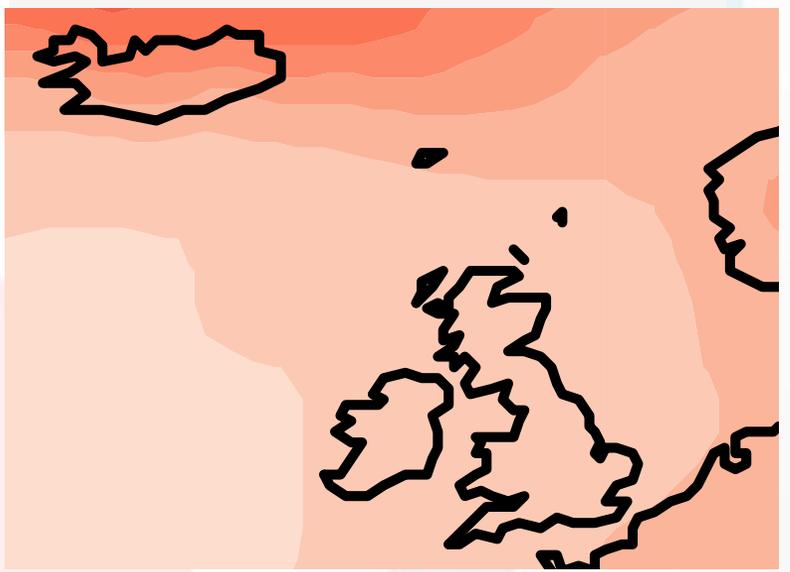
Robert Jones, Aquaculture Lead,
The Nature Conservancy



change (°C)

relative to 1850-1900

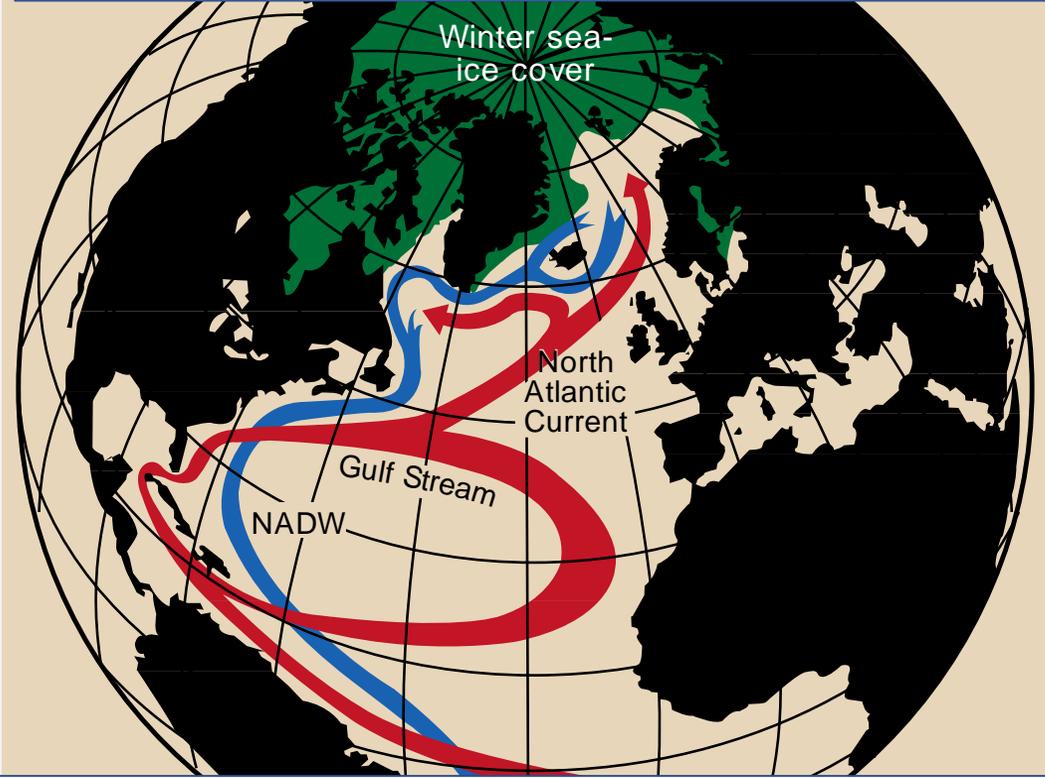
Simulated change at 1.5 °C global warming



Source: IPCC AR6

What will happen to my home? 

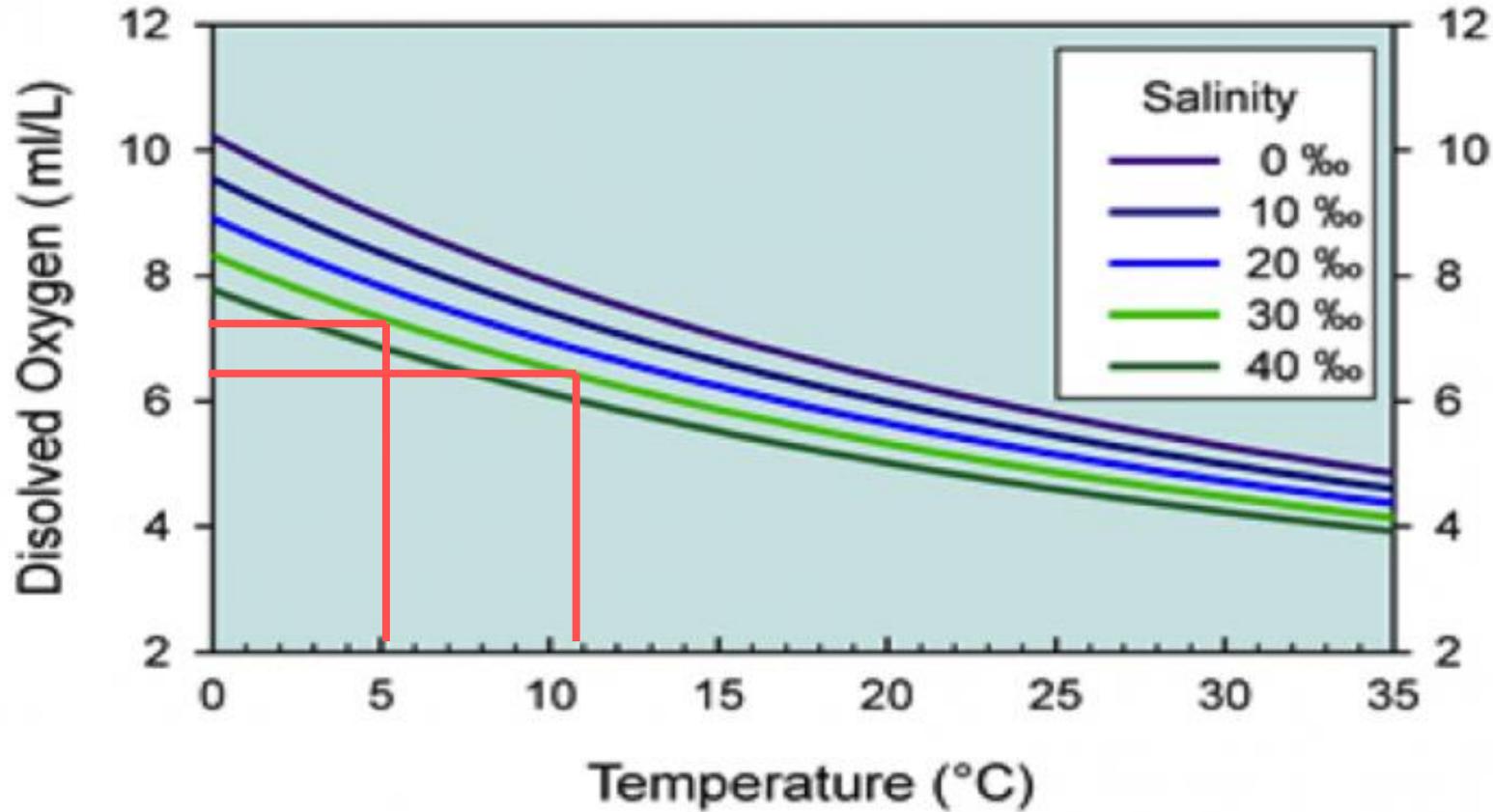
That depends on the Atlantic meridional overturning circulation (AMOC)



The AMOC is a large system of ocean currents, like a conveyor belt, driven by differences in temperature and salt content

Source: NATURE | VOL 388 | 28 AUGUST 1997

Oxygen Concentration vs Temperature in (Sea) Water

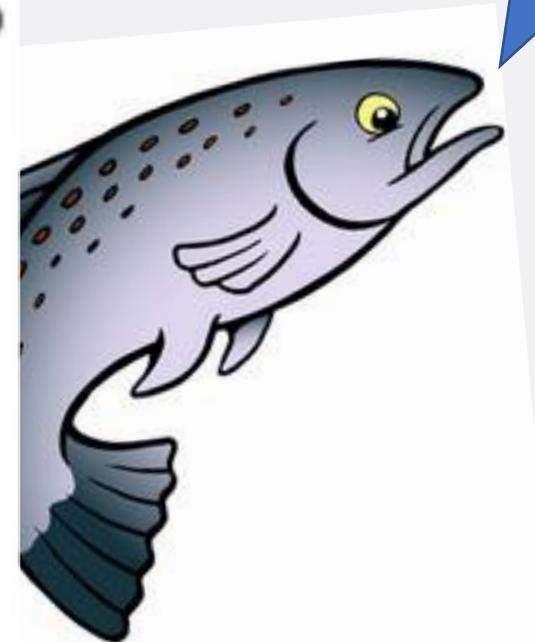


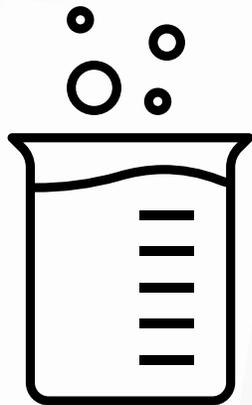
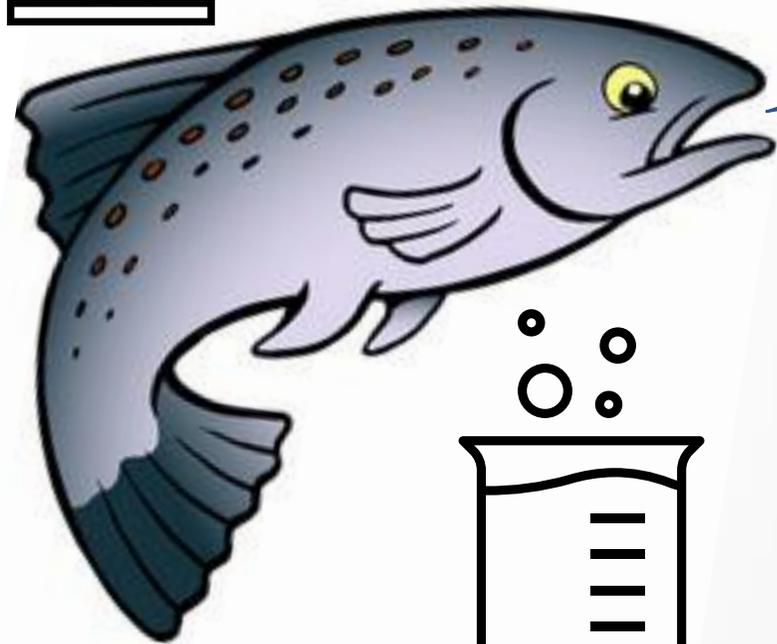
I'm so happy right now!!

6.5-7 mg/L DO

5-11 °C

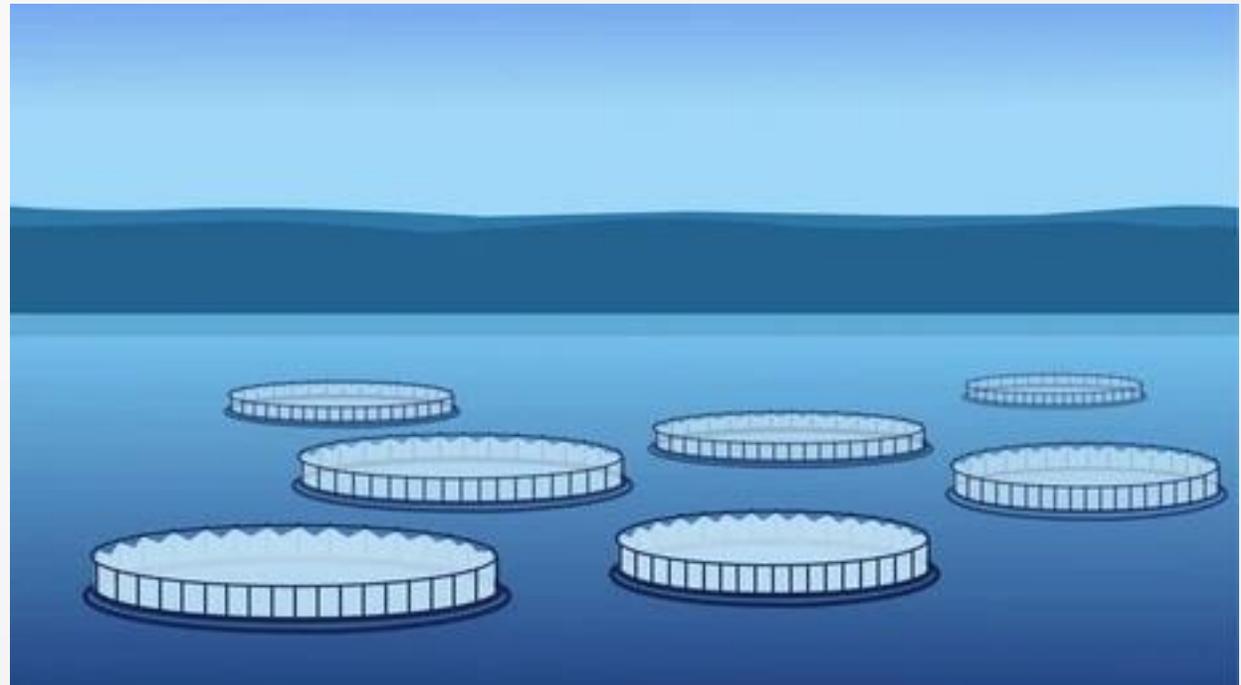
35‰ salinity

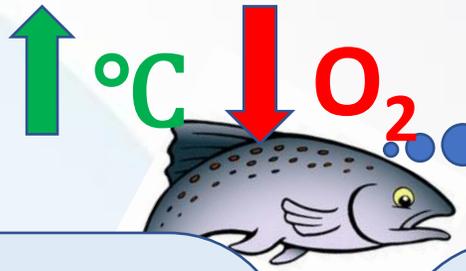




I'm part of the research team

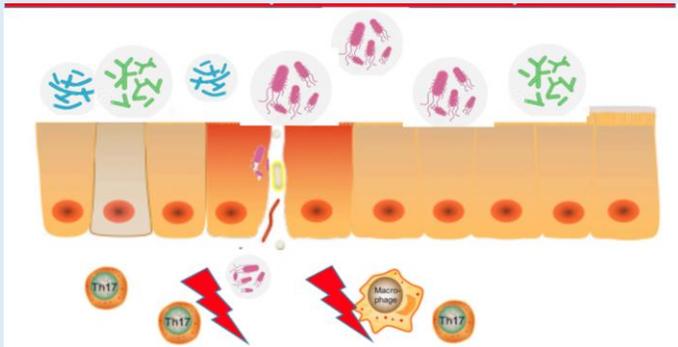
- I live in a cage and can't swim away
- I can be collected and measured





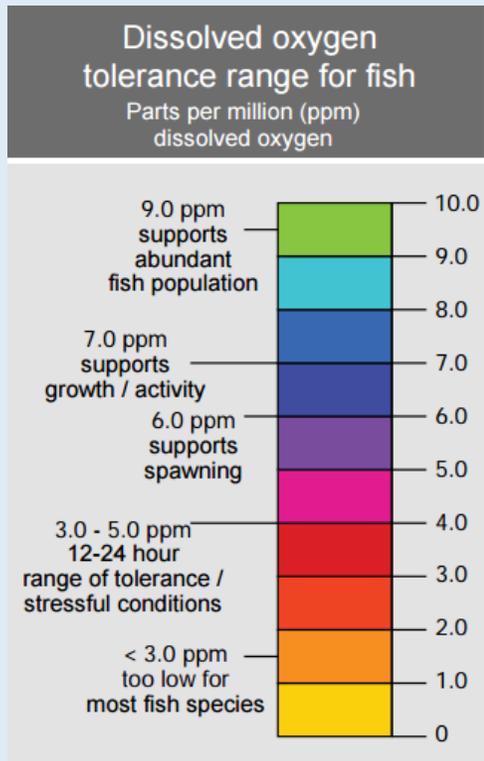
I wonder how much I can tolerate...

Chronic stress makes it harder to fight infections



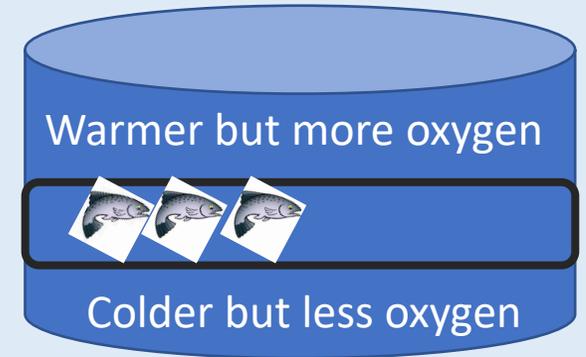
↓ Immune Function

High energy cost to extract O₂



↓ Growth

Move toward higher O₂
Move away >20.1 °C



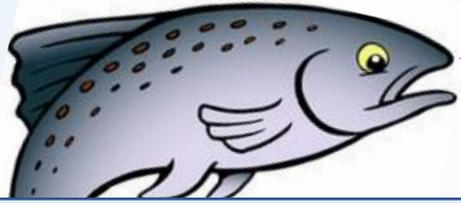
SCIENTIFIC REPORTS

OPEN Response of Atlantic salmon *Salmo salar* to temperature and dissolved oxygen extremes established using animal-borne environmental sensors

Received: 8 February 2017
Accepted: 22 May 2017
Published online: 03 July 2017

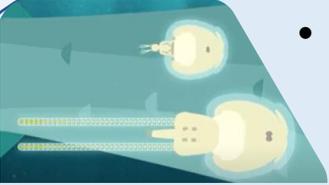
Kilian M. Stehfest, Chris G. Carter, Jaime D. McAllister, Jeff D. Ross & Jayson M. Semmens

↻ Behavior

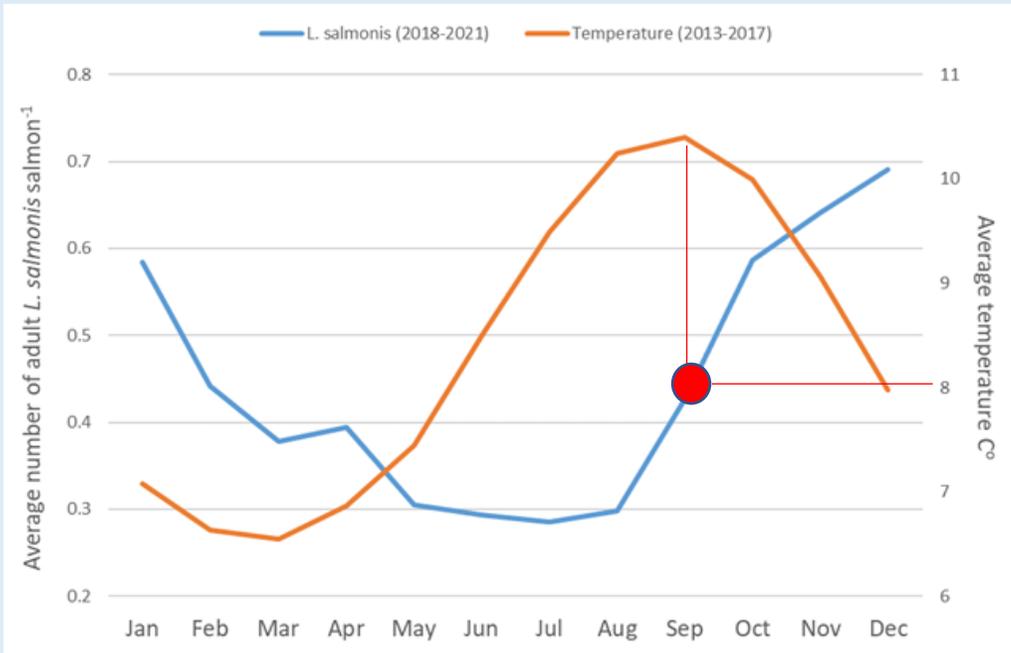


Stop irritating me!

↑ °C ↓ O₂



- Sea lice harm salmon
 - Causes skin damage and stress
 - Makes salmon susceptible to other infections

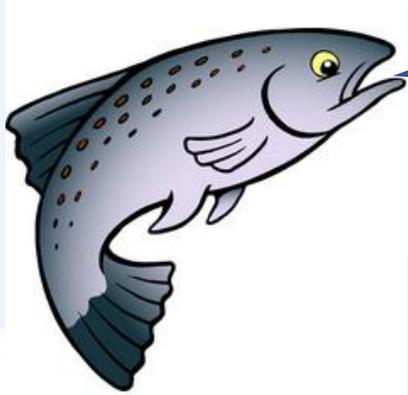


Kirstin Eliassen

The effect of a warmer climate on the salmon lice infection pressure from Norwegian aquaculture

Anne D. Sandvik *, Sussie Dalvin, Rasmus Skern-Mauritzen, and Morten D. Skogen

Institute of Marine Research, PO Box 1870, Bergen, Norway



I know some of you are important food for some of my neighbors ...
But I find you quite harmful!

Microalgae are:

1. Microscopic organisms at the bottom of the food chain
2. Capable of photosynthesis
3. Multiply with light and high temperatures, excess nutrients in the water
4. Can irritate gills and suffocate fish in large quantities
5. Can produce toxins



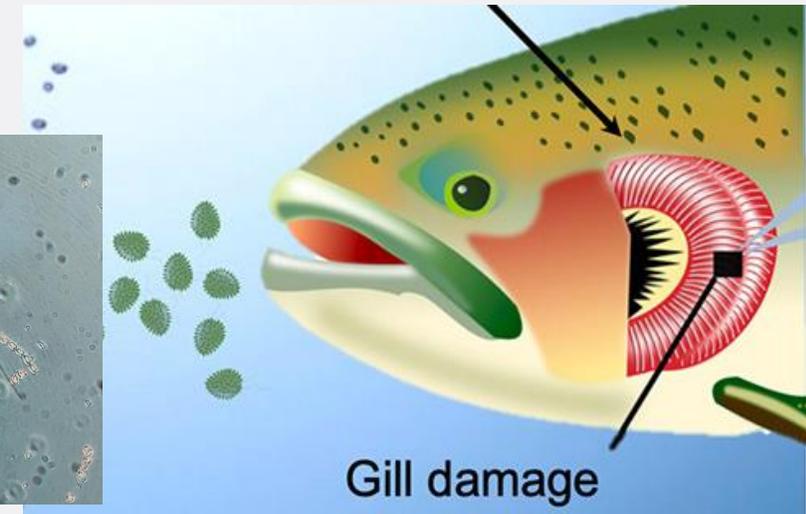
UNESCO

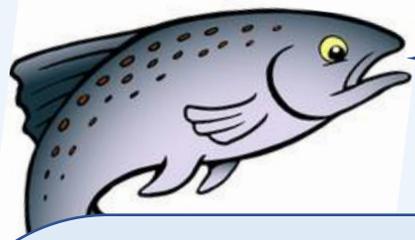
Building peace in the minds of men and women

Intergovernmental Oceanographic Commission

Harmful Algal Bloom Programme

Today, virtually every coastal country in the world is affected by harmful blooms of microscopic algae or phytoplankton. These blooms can kill marine life and even cause death in humans. The IOC's International Harmful Algal Bloom (HAB) Programme works to help Member States develop the research and management capacity needed to understand the causes of these blooms, predict their occurrences, and mitigate their effects.

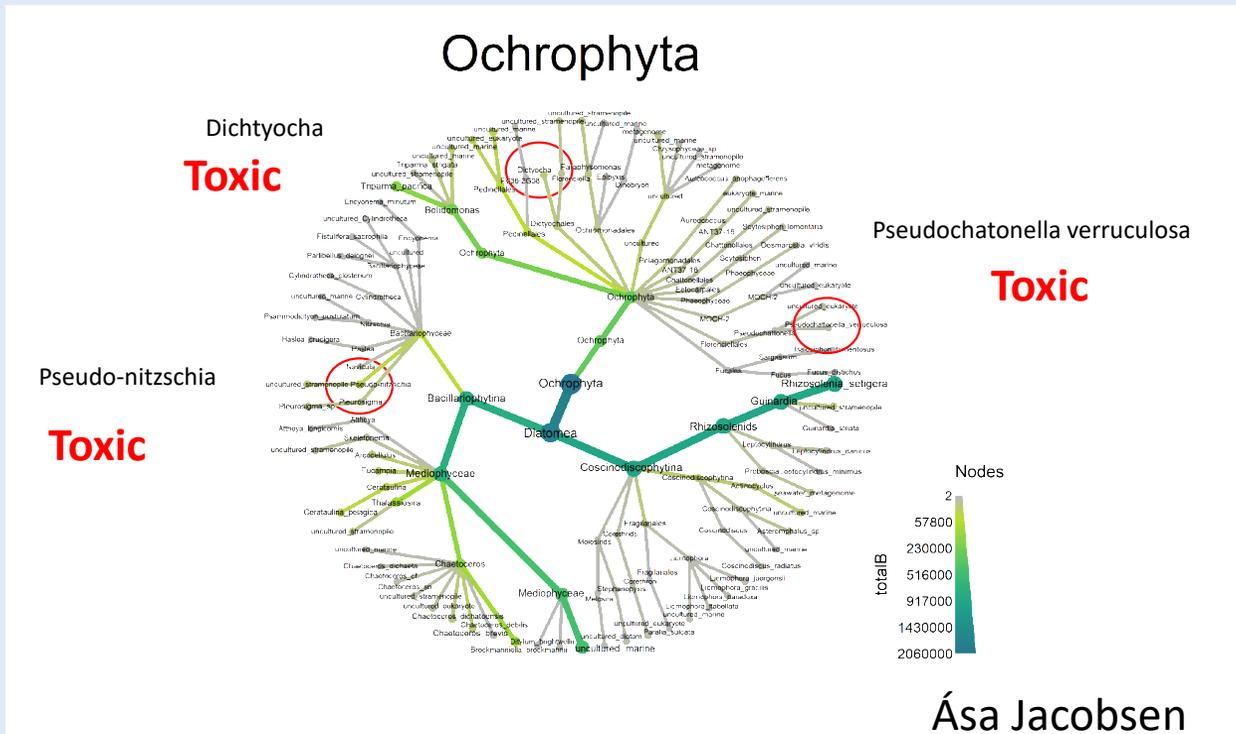




Fiskaaling is identifying and counting microalgae during the summer so they can warn about potential problems with my health.



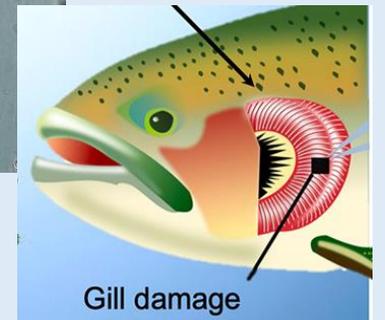
By sequencing the DNA we can **identify** all the species present



Using the microscope we can **count** how many microalgae are in the sample

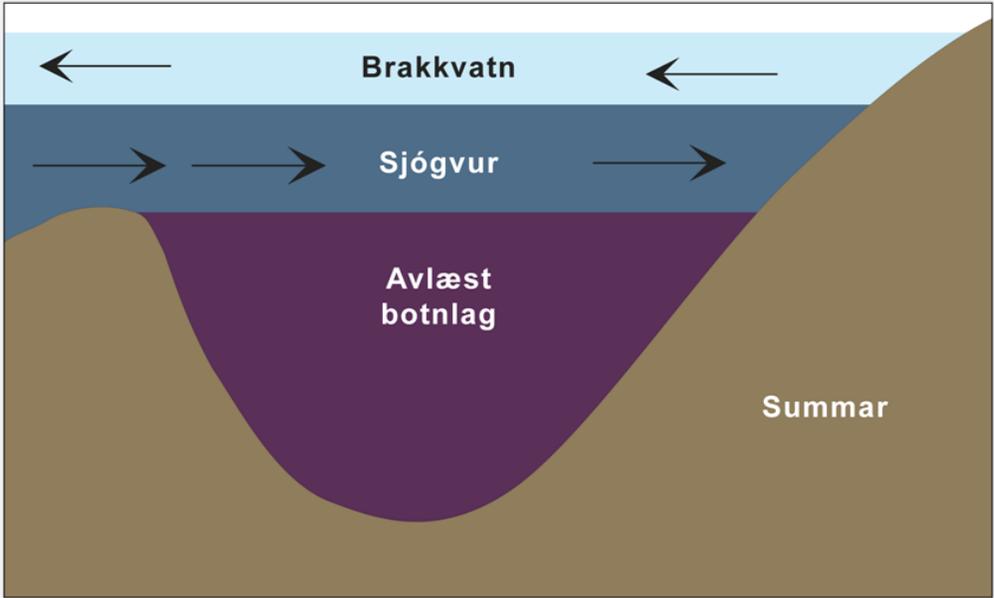
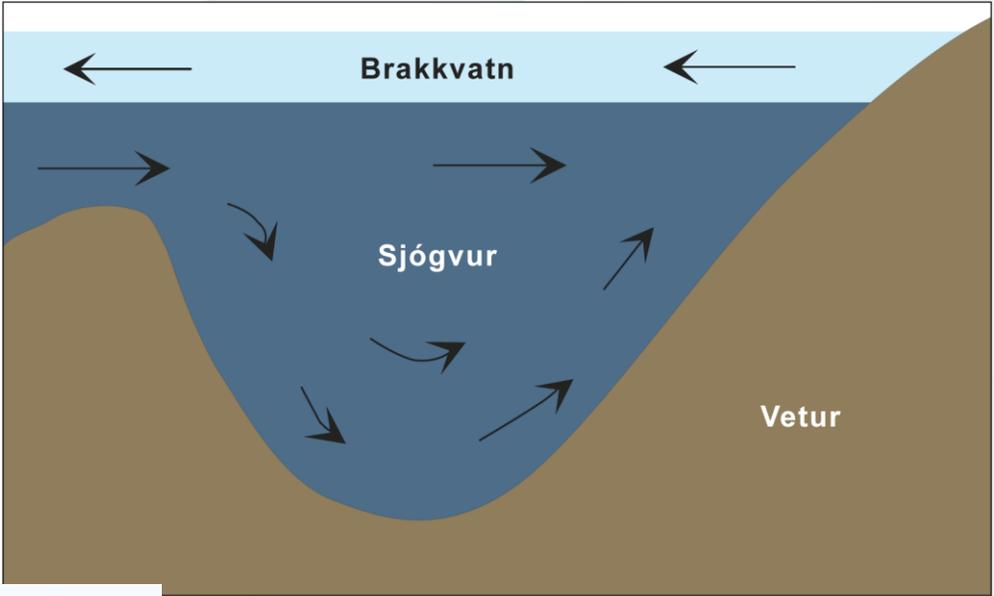
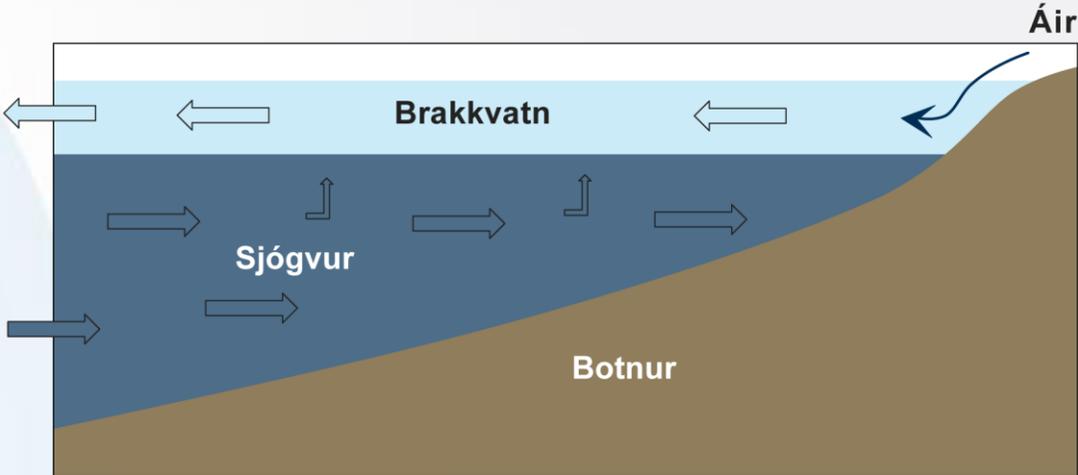
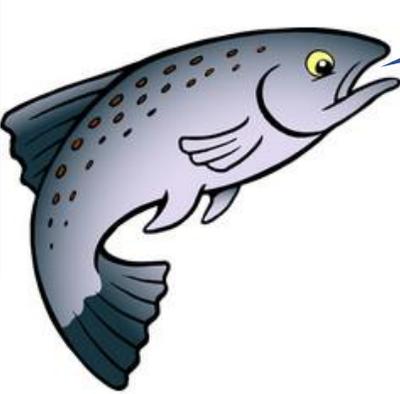


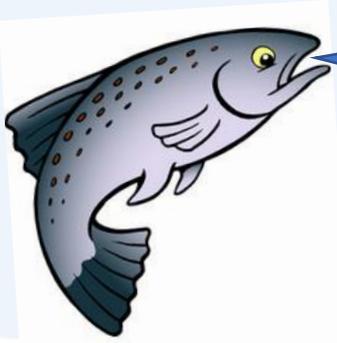
Chaetoceros decipiens



Elin Jacobsen
Eirikur Danielsen

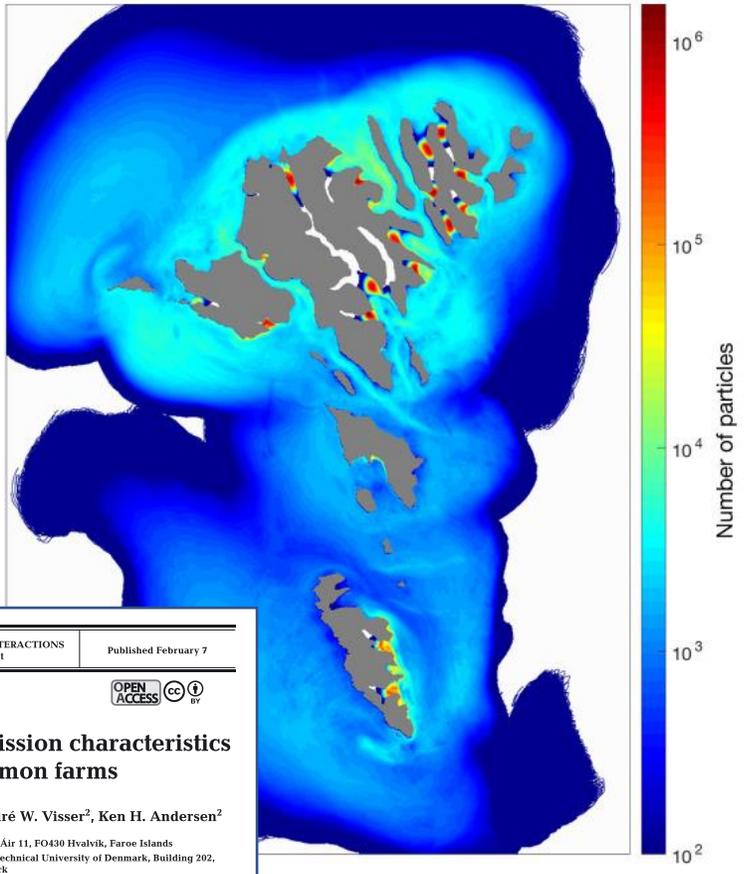
My view depends on what kind of area I live in





Fantastic to have some models of my neighborhood!

Particle-tracking model of lice transmission



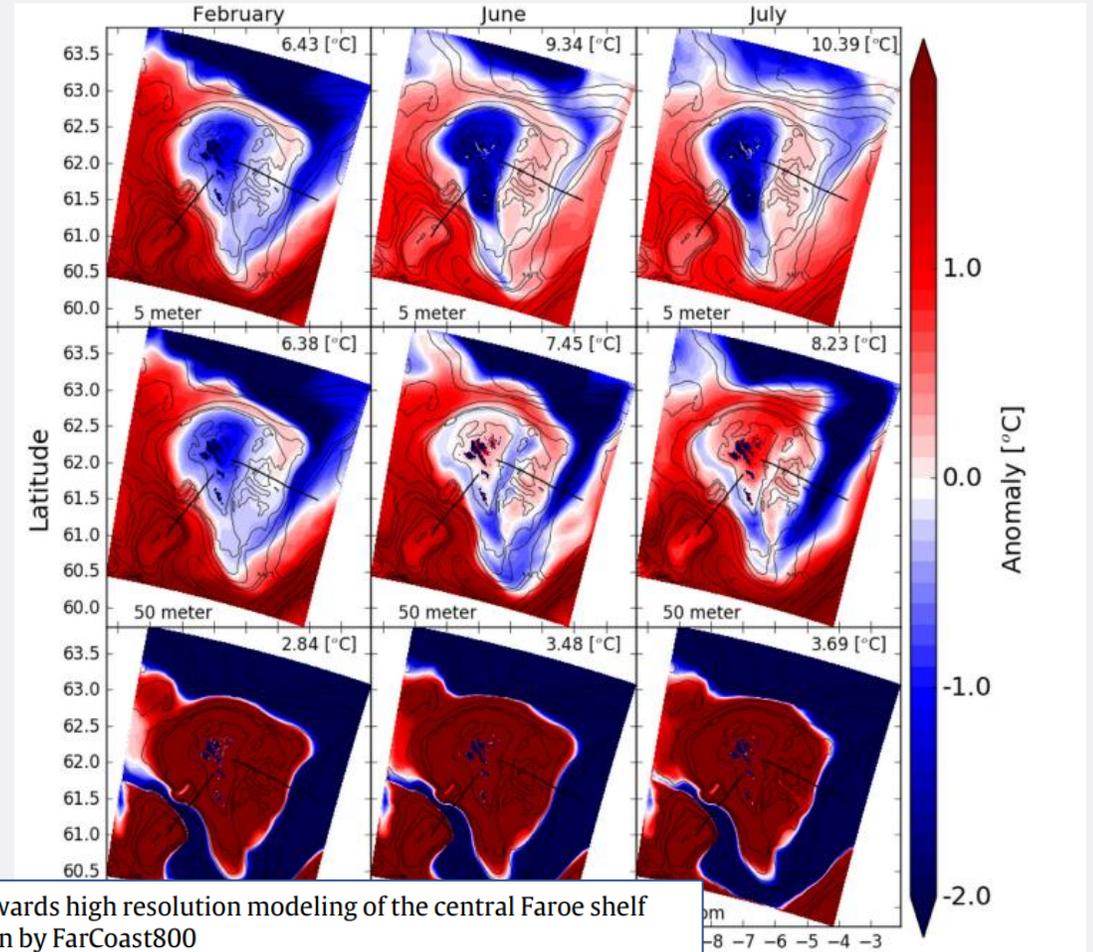
Vol. 10: 49-60, 2018 AQUACULTURE ENVIRONMENT INTERACTIONS Published February 7
<https://doi.org/10.3354/aei00252> Aquacult Environ Interact

Identifying salmon lice transmission characteristics between Faroese salmon farms

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²VKR Centre for Ocean Life, National Institute of Aquatic Resources, Technical University of Denmark, Building 202, 2800 Kgs. Lyngby, Denmark

High-resolution modeling of temperature at different depths



A step towards high resolution modeling of the central Faroe shelf circulation by FarCoast800

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^dInstitute of Marine Research, P.O. box 1870 Nordnes, NO-5817, Bergen, Norway



The importance of calibrating climate change projections to local conditions at aquaculture sites



Lynne Falconer^{a,*}, Solfrid Sætre Hjøllø^b, Trevor C. Telfer^a, Bruce J. McAdam^a, Øystein Hermansen^c, Elisabeth Ytteborg^c

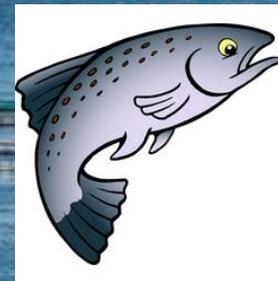
^a Institute of Aquaculture, University of Stirling, FK9 4LA, Scotland, UK

^b Institute of Marine Research, Box 1870 Nordnes, 5817 Bergen, Norway

^c Nofima, Muninbakken 9-13, Breivika, Box 6122 Langnes, NO-9291 Tromsø, Norway



“Bird’s eye”



“Salmon’s view”

There is an urgent need to implement **long-term monitoring** and data collection campaigns at aquaculture sites to understand how the environment is changing

Thanks to my Fiskaaling colleagues



@Fiskaaling



Fiskaaling P/F