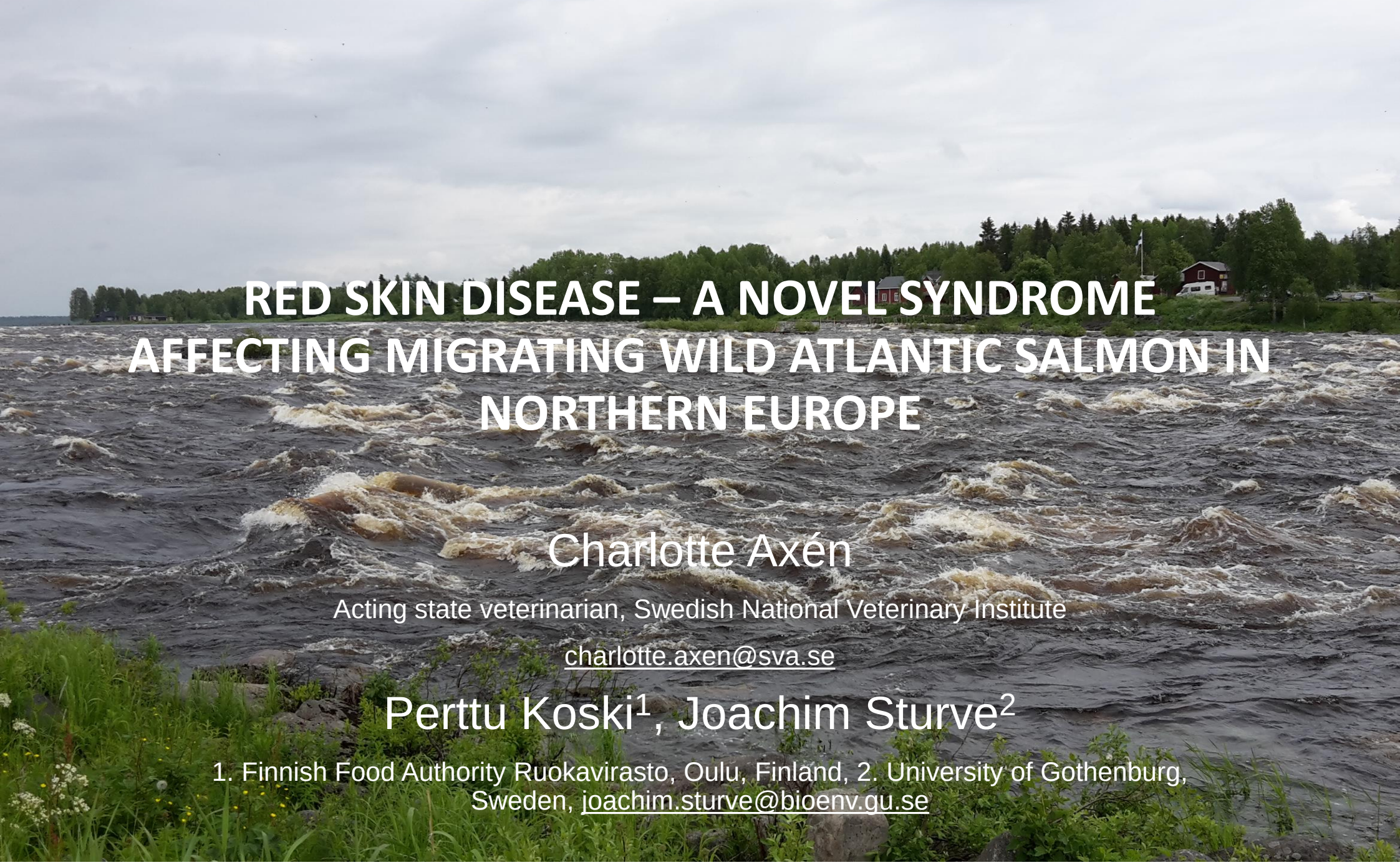


RED SKIN DISEASE – A NOVEL SYNDROME AFFECTING MIGRATING WILD ATLANTIC SALMON IN NORTHERN EUROPE

Charlotte Axén

Acting state veterinarian, Swedish National Veterinary Institute

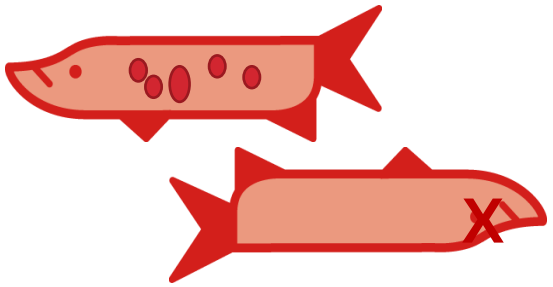
charlotte.axen@sva.se

Perttu Koski[1], Joachim Sturve[2]

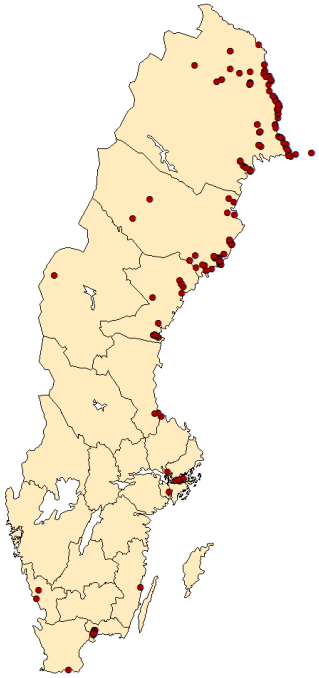
1. Finnish Food Authority Ruokavirasto, Oulu, Finland, 2. University of Gothenburg, Sweden, joachim.sturve@bioenv.gu.se

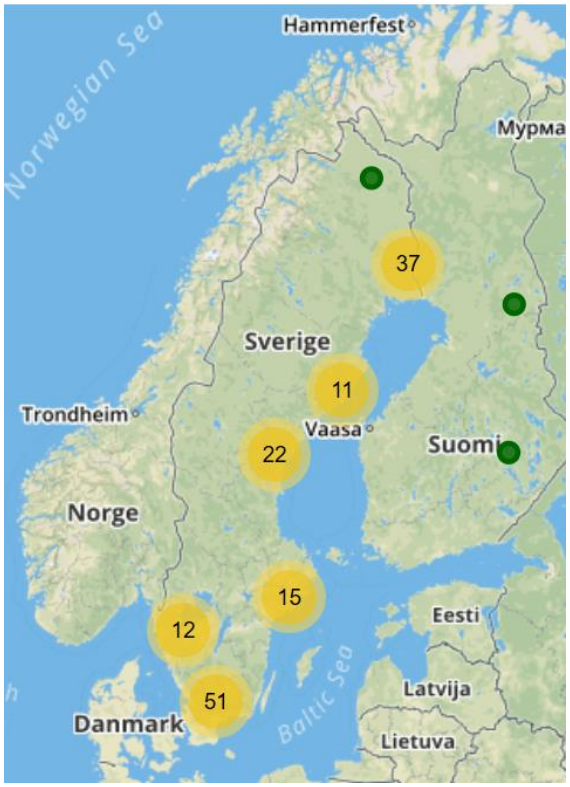
RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

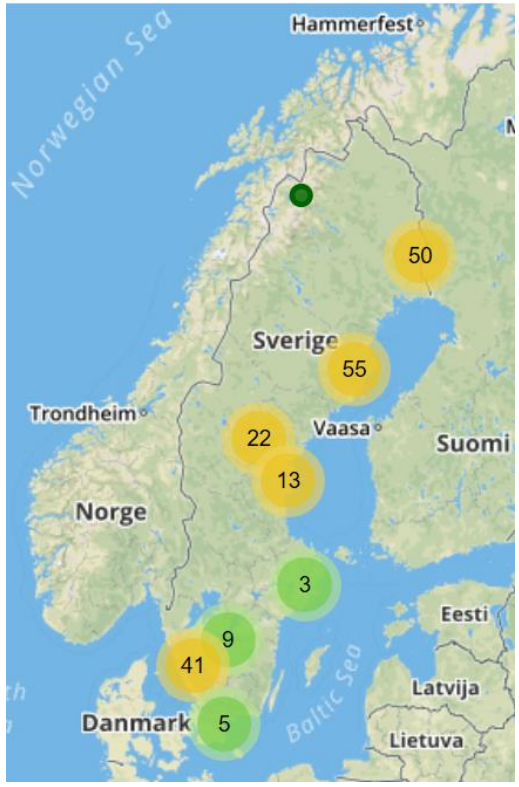
REPORTING SITE:
HTTPS://RAPPORTERAFISK.SVA.SE

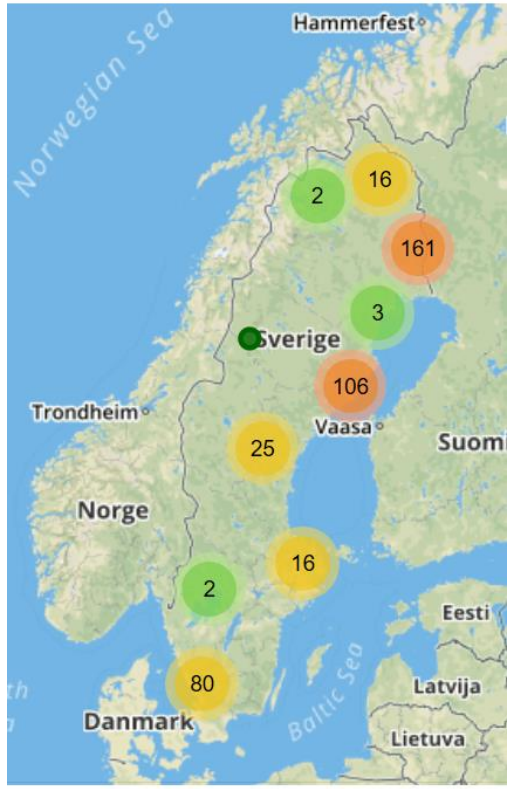


2016 (from May) 2017 2018 2019







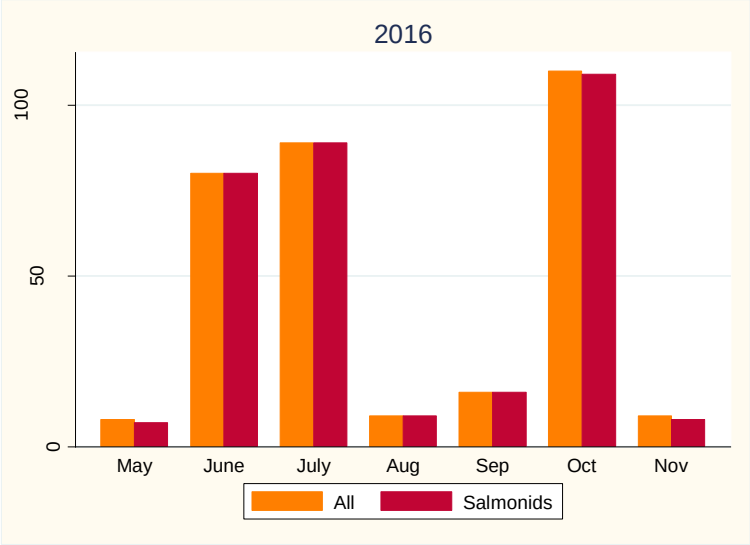


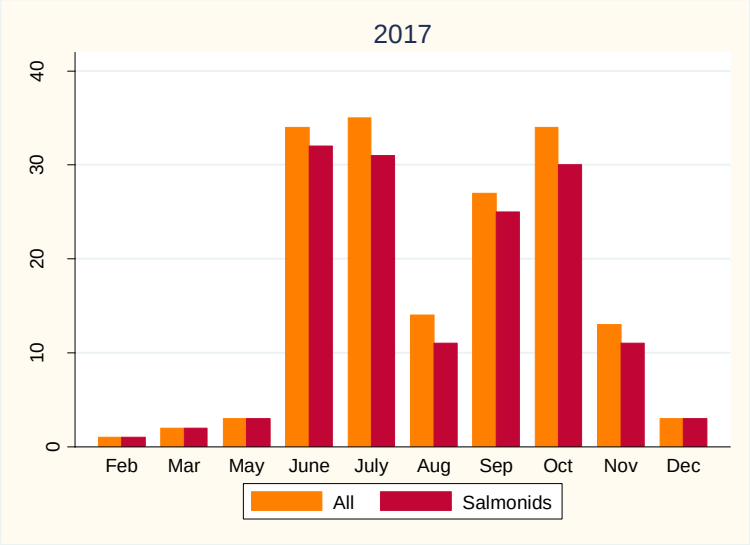
N=321 N=166 N=238 N=466

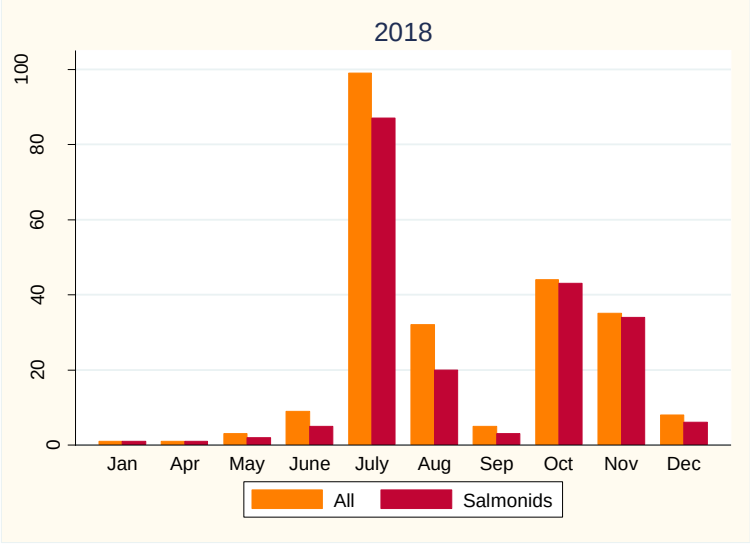
RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

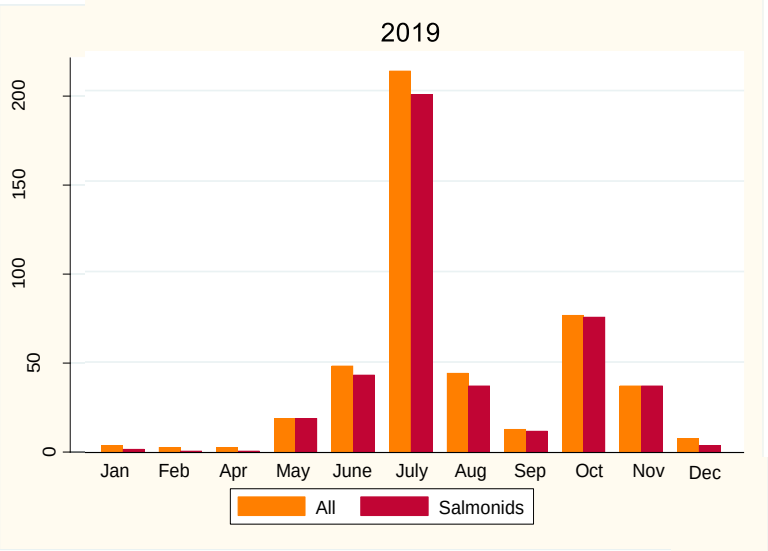
WHAT IS REPORTED?

REPORTS









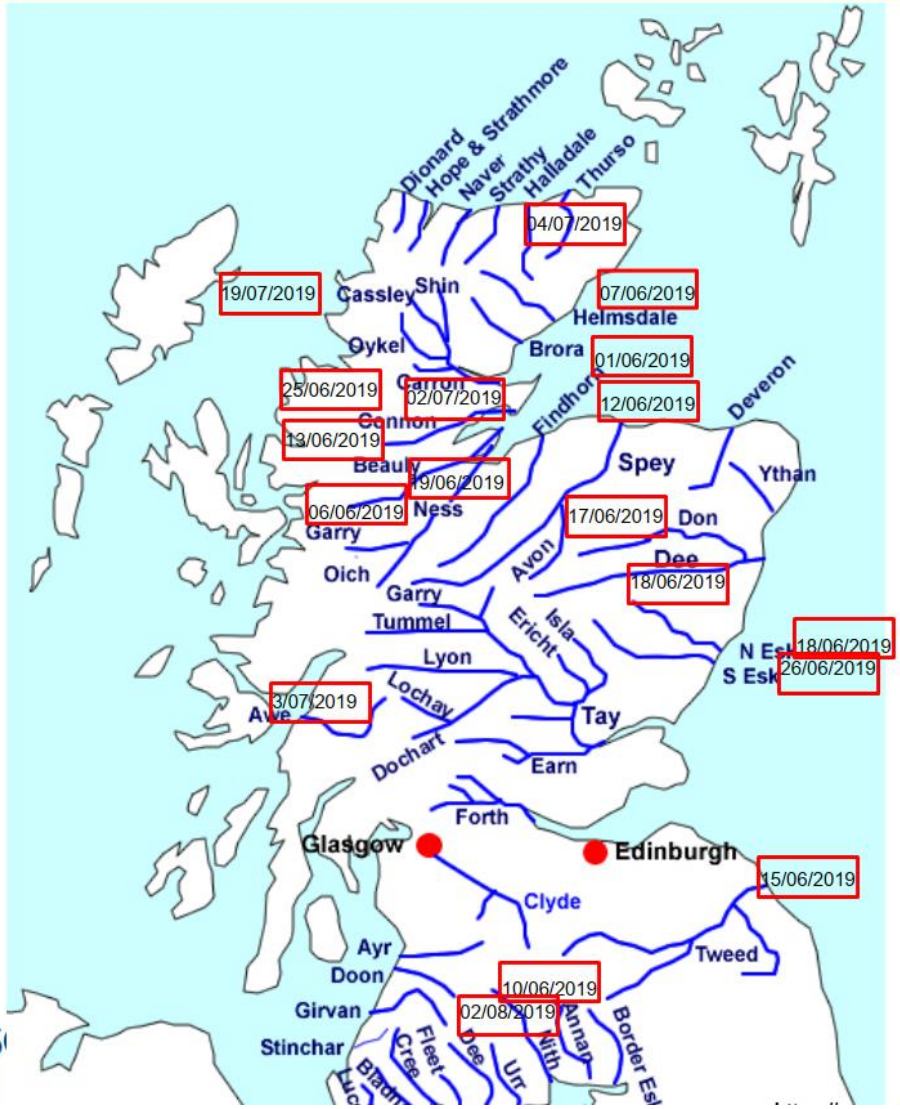
RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

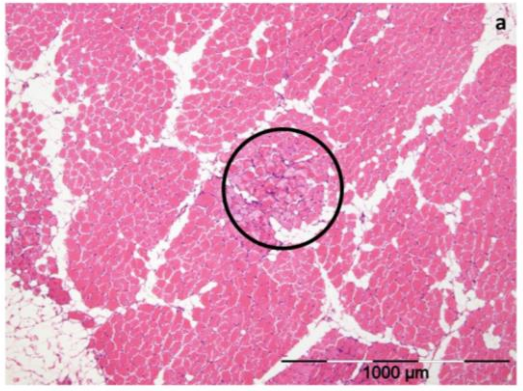
2019…..

RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

SCOTLAND

2





Muscular lesions as circled above observed from multiple rivers. Not related to *Saprolegnia* sp. infection.

marines science

RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

SVA

IRELAND

Reported incidences

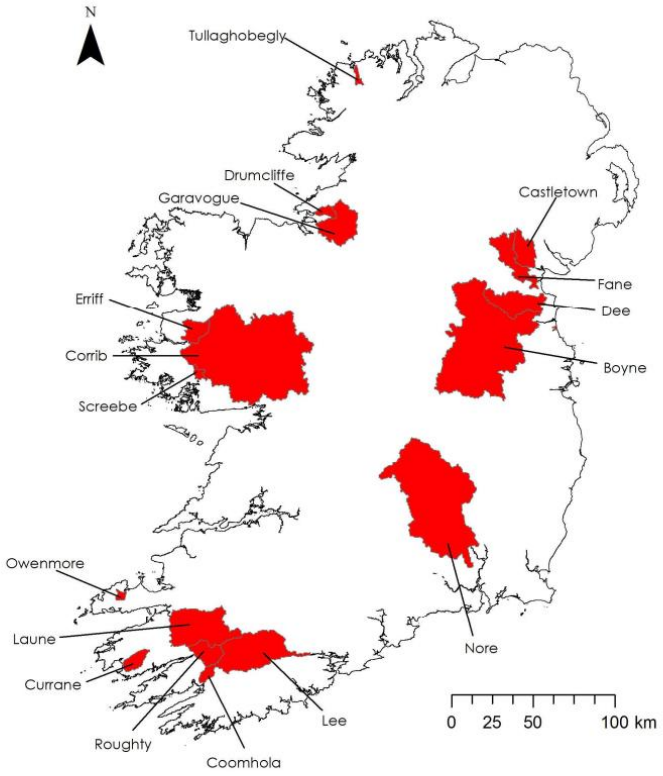
17 rivers

56 fish

Mainly anglers

Also draft, traps

Very low reports nationally (c. 31,000 salmon caught annually in IRL)



Corrib Cong 10-07-2019

Erriff 21-06-2019

Timeline of reports

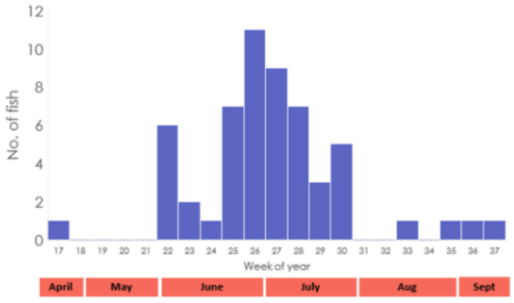
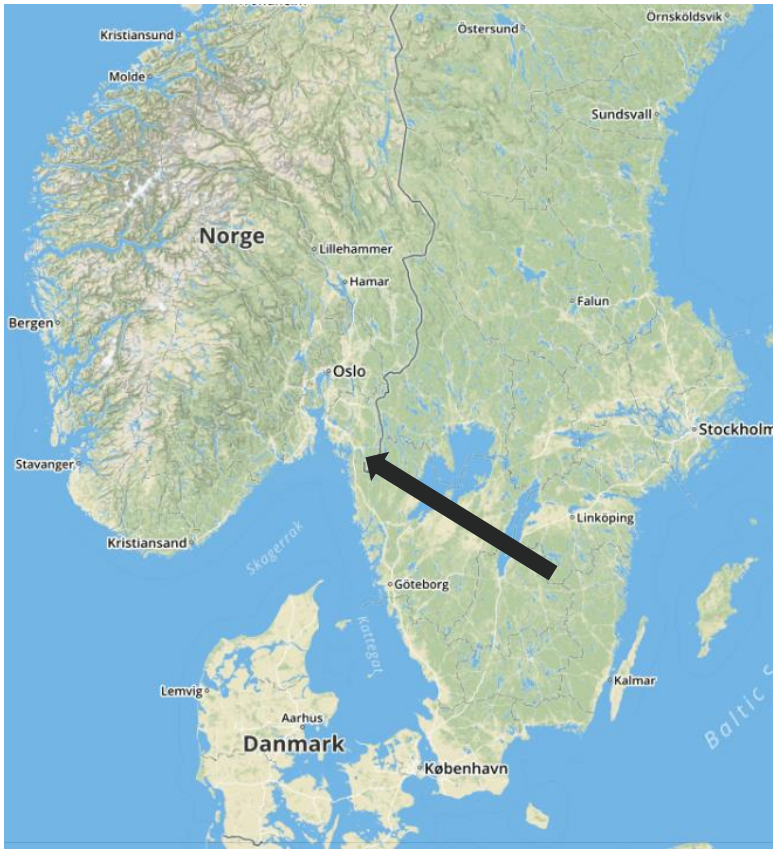


Figure 1 Frequency of reports of Atlantic with signs of red rash skin disease in Ireland in 2019.

NORWAY


Kristiansund
Östersund
Örnsköldsvik
Molde
Sundsvall
Norge
Lillehammer
Hamar
Falun
Bergen
Oslo
Stockholm
Stavanger
Linköping
Kristiansand
Skagerrak
Göteborg
Kattegat
Kalmar
Lemvig
Aarhus
Danmark
København
Baltic

DENMARK

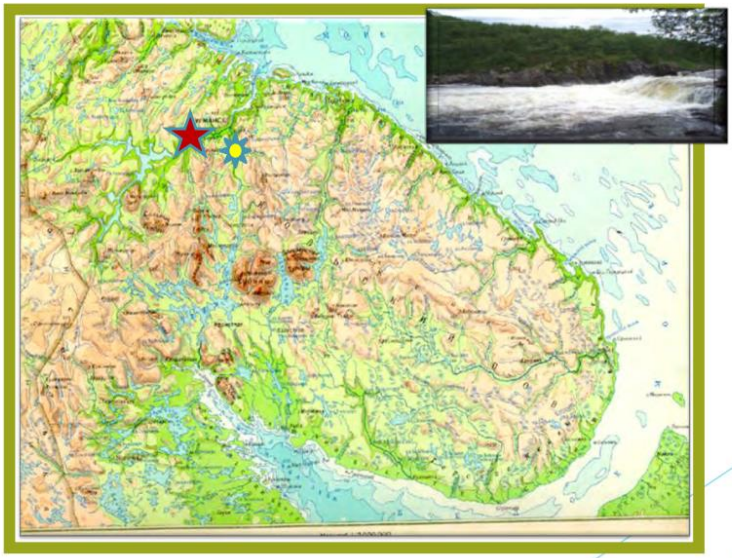
A. salmon from Gudenåen

A. salmon from Skjerne å

RUSSIA

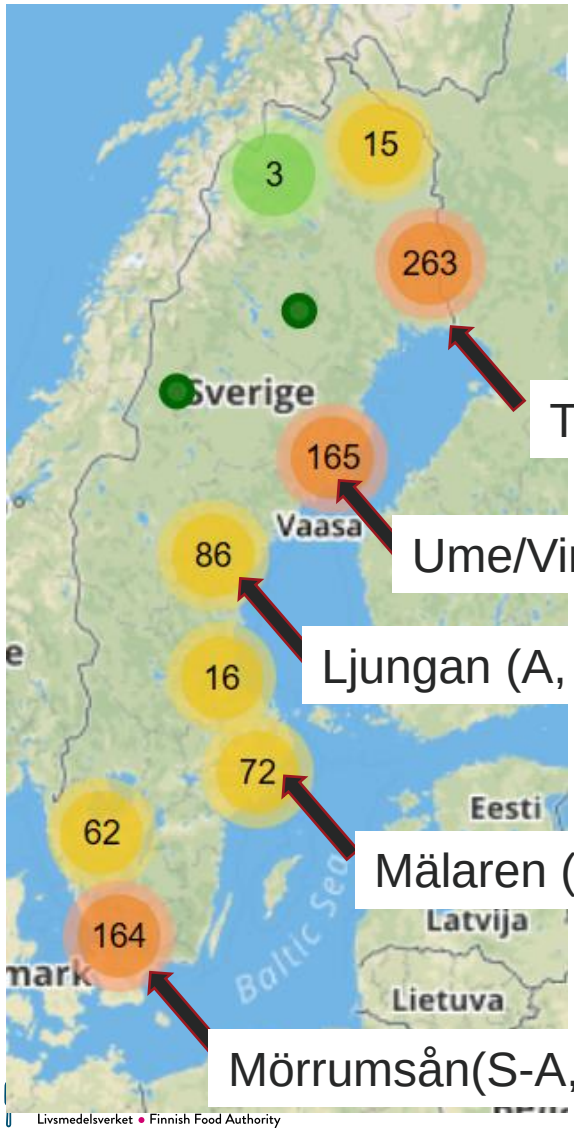
Tuloma riv.

Kola riv.



INVESTIGATIONS 2016

Total number of reports 2017-2019



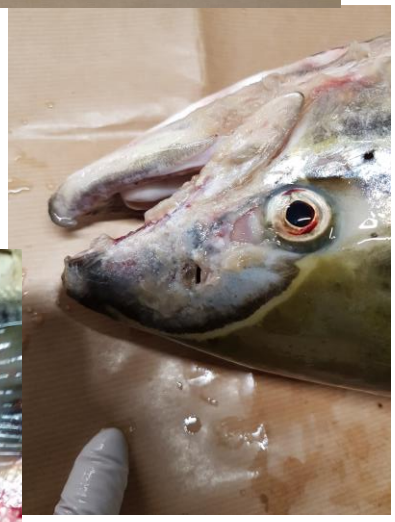
Torneälven (S, W)

Ume/Vindelälven (S, W/R)

Ljungan (A, W/R)

Mälaren (A, R)

Mörrumsån(S-A, W/R)

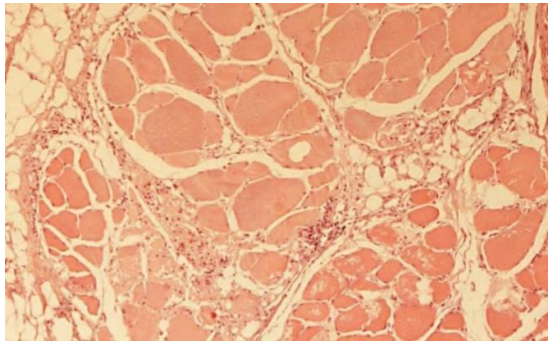


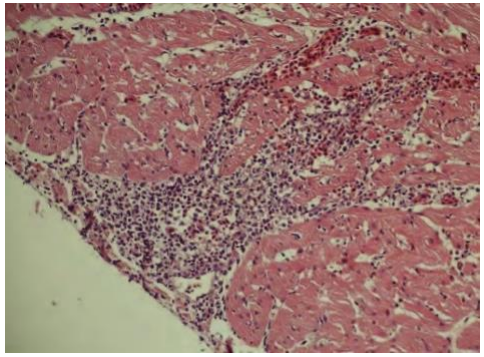
S=summer
A=Autumn
W=wild
R=restocking

Livsmedelsverket • Finnish Food Authority

INVESTIGATIONS 2016

- Viral cultivation negative
  - ISAV neg
  - SAV neg
  - 1 PRV-1
  - DNA-analys: herpes- and iridovirus-like sequences
- A few bacterial infections
- Saprolegnia
- Histopathology
  - UDN
  - Muscle necrosis
  - Inflammation
    - Skin + muscle
    - Heart
- Cytology
  - Immature RBCs
  - WBCs



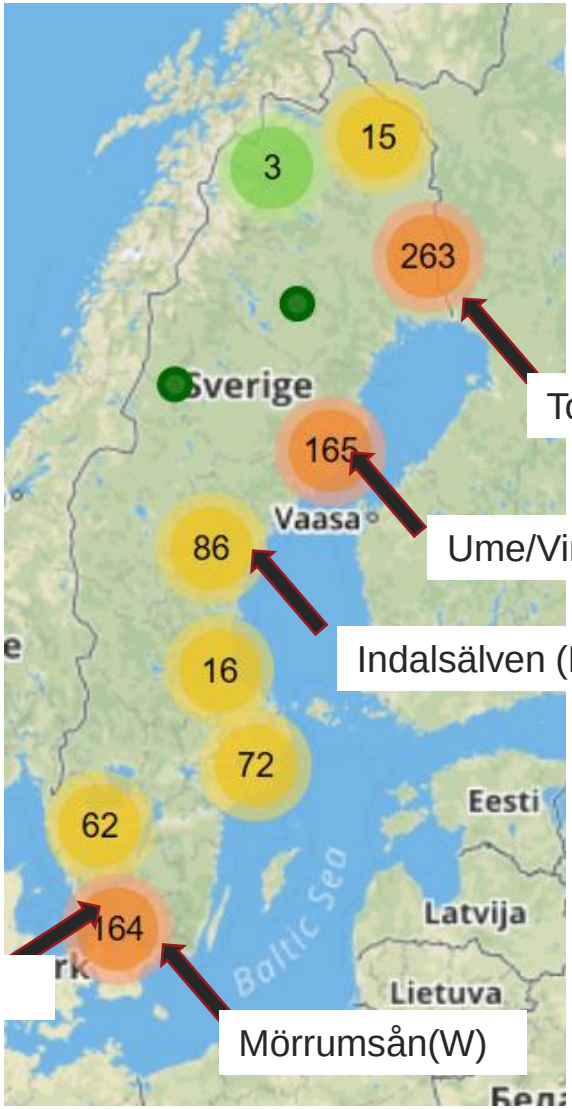


INVESTIGATIONS 2018

- Torneälven (n=20 S, W)
- Ume-/Vindelälven (n=30 S, R/W)
- Indalsälven (n=20 S-A, R)
- Mörrumsån (n=4 S, W)
- Lagan (n=13 A, R (W))

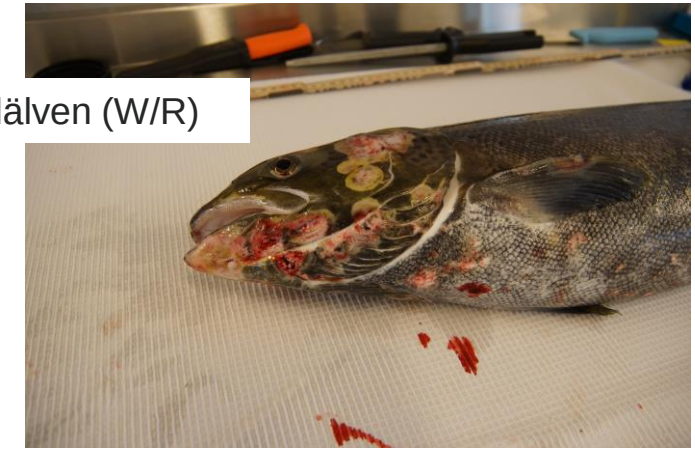
S=summer
A=Autumn
W=wild
R=restocking

Total number of reports 2017-2019



Torneälven (W)

Ume/Vindelälven (W/R)



Indalsälven (R)

Lagan (R)

Mörrumsån(W)

RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

INVESTIGATIONS 2018

- Biomarkers ➡
- Disease signs
- HP spleen, kidney
- Fungus
- Vitamins
  - Thiamine
  - α-Tocopherol
  - Carotenoids
    - Astaxanthin
    - Vitamin A
      - Retinol

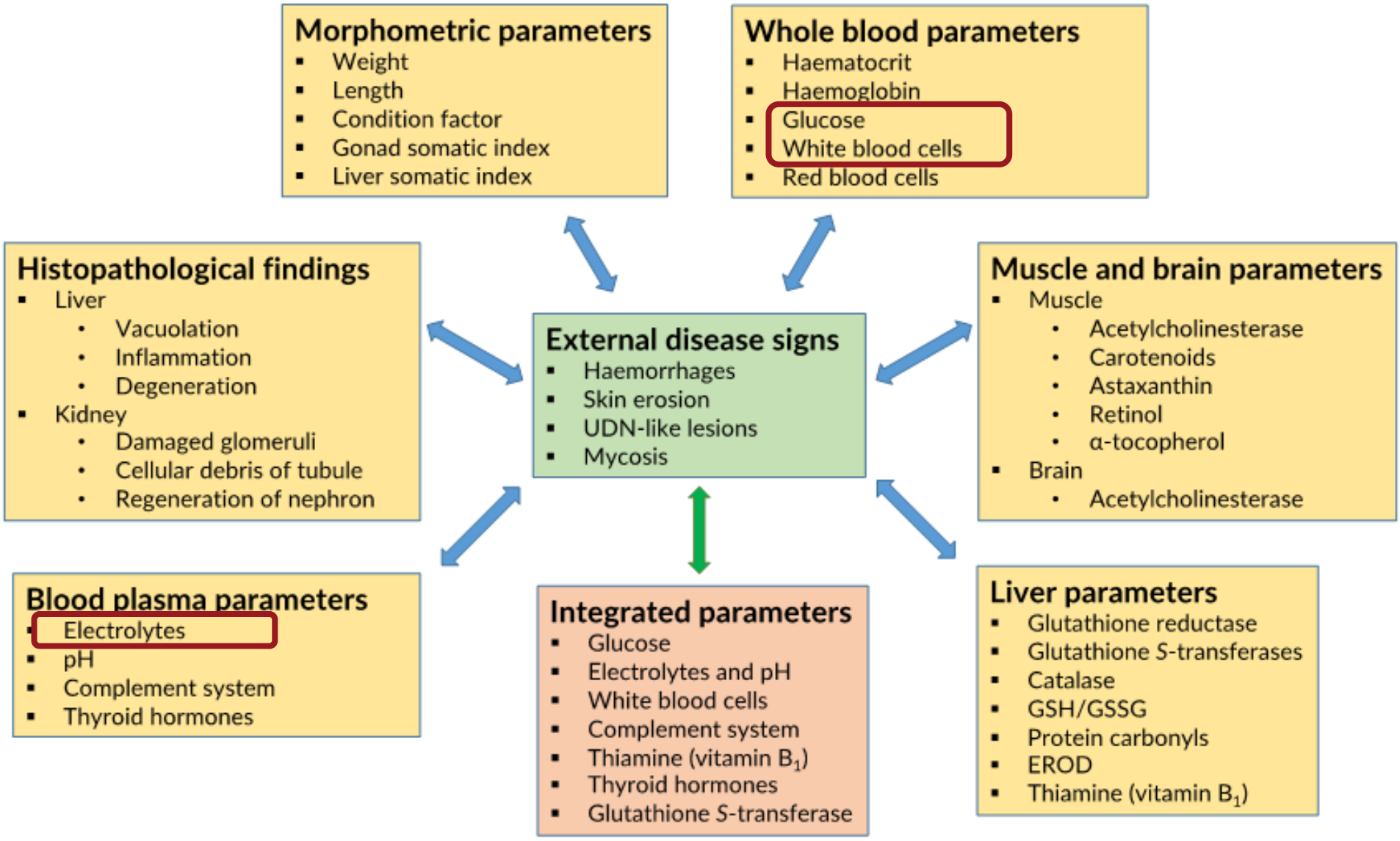
Parameter	Variabel / biomarker
Energy Growth Condition	Total body weight, somatic weight, lenght, age, CF
Reproduction	Gonado-somatic index (GSI)
Endocrine disorders	Thyreoid hormones (T3 o T4) in plasma + ratio T3/T4
Liver function Detoxification Oxidative stress	Liver somatic index (LSI), liver histology, EROD activity, glutathion reductase, glutathion S-transferase, catalase.
Genotoxicity	Mikronuclei in RBCs
Carbohydrate metabolism Stress	Blood glucose
Oxygen transport	Hematocrit, Hemoglobin, immature RBCs
Immune system	Total WBCs, WBC diff, thrombocytes, complement factors
Osmotic balance Cell damage	Ion levels (chloride, sodium, potassium, calcium) in plasma

BIOMARKERS, VITAMINS

River (No of fish)	Htk	Glu	Na+ Cl^-	tT3,fT3	tT4,fT4	Vit B1	Carot	Vit E	EROD	iRBC	
Mörrumsån (4)	→	→	→	→	→	→	→	→	→	(→)	Low grade sings
Torneälven (14)	↑	→	→	↑↑	↑→	→	→	→	↑	↑	”Healthy” – pollution?
Umeälven (22)	↑	↑	↓	→	↑↑	(→)	→	→	→	(→)	Diseased
Indalsälven (13)	ND	ND	→	→	→	→	→	→	→	→	Healthy
Lagan (13)	→	→	→	→	→	↓	↓	↓	→	→	Spawners

RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

MULTIVARIATE ANALYSIS

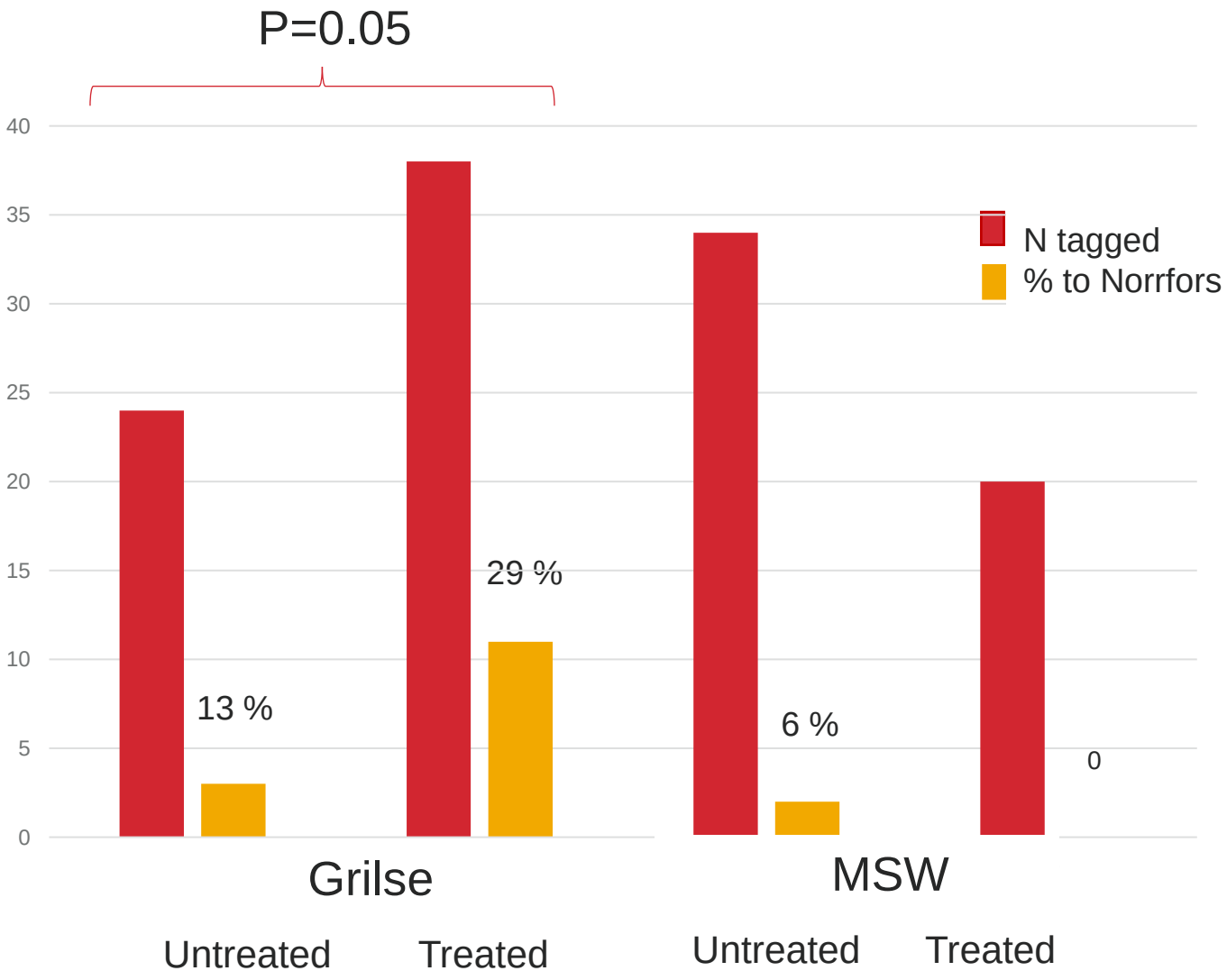


Weichert, F. et al (2020). A multi-biomarker study on Atlantic salmon (*Salmo salar* L.) affected by the emerging Red Skin Disease in the Baltic Sea. J fish Diseases. Accepted 7 Oct 2020. DOI: 10.1111/jfd.13288

THIAMINE CC TRIAL IN UMEÄLVEN 2018

- Migration monitoring – PIT tagging at the estuary, monitoring at the fish ladder in Norrfors (appr 20 km upstream)
- 2-13 July: Thiamine treatment (50 mg/fish
  - 116 tagged, 50% treated

RESULTS

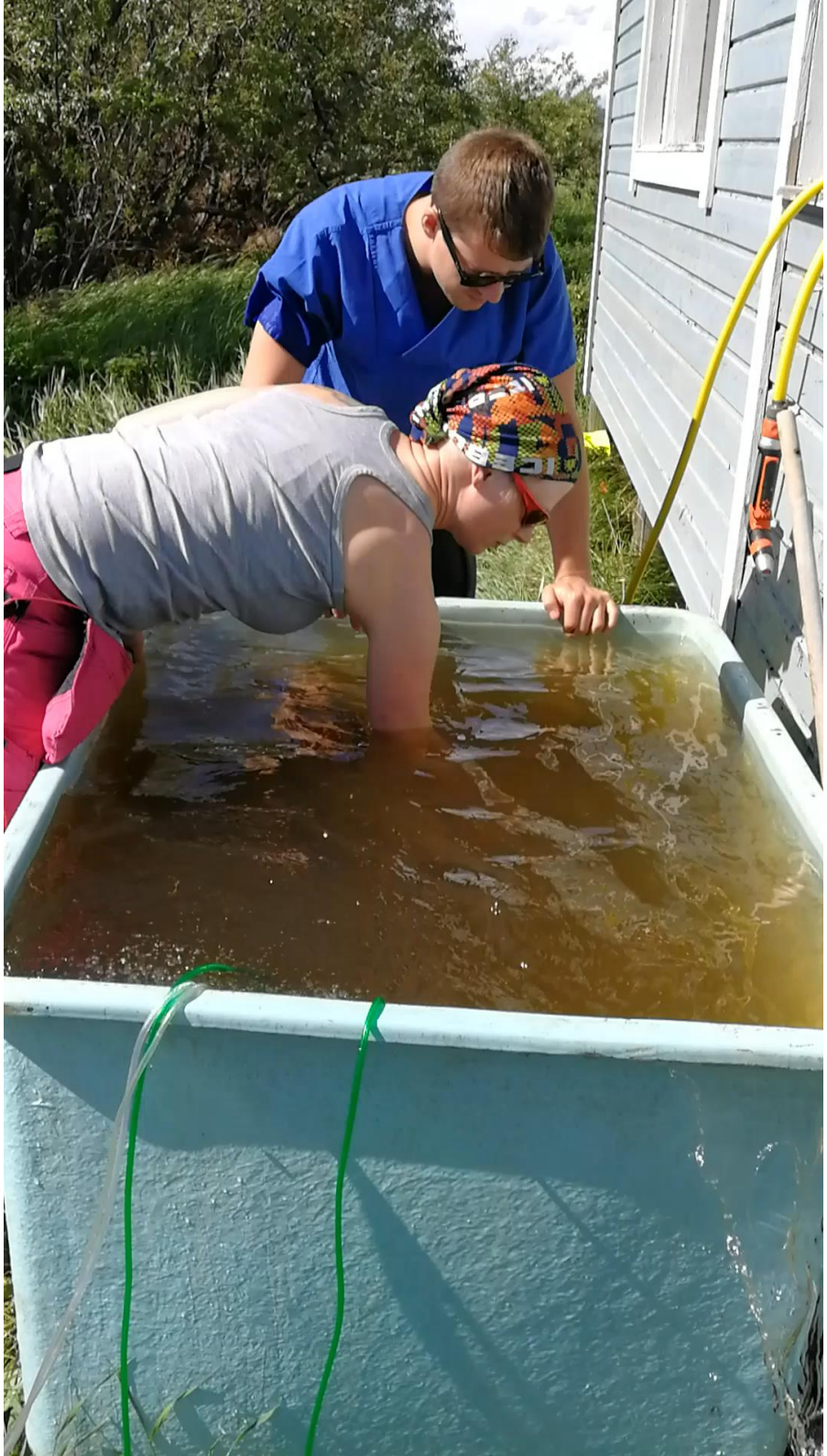


RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

WHERE DO WE GO NOW?

- Monitoring program for Swedish salmonids started
  - Samplings 2020, work in progress – HP/cytology, biomarkers, metabolomics, thyreoid status, vit B (B1 & possibly B9, B12)
  - Virus? Exosomes, IgM, skin cell cultures, new cell lines, EM
  - Samplings 2021?
- International network
  - Updates
  - Possibilities to share samples
  - Application in progress, GWAS (RSD and M74)

THANK



YOU

RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority