# 2018 Salmon Summit – Panels & Presentations

**Panel 1: Scientific update** - Latest scientific news and data from Europe and North America, focusing on population trends and challenges (natural and man-made) facing N. Atlantic salmon

- Jon Carr, Atlantic Salmon Federation
- Ken Whelan, Atlantic Salmon Trust
- Torbjørn Forseth, Norwegian Institute for Nature Research

**Panel 2: High Seas buy outs** - Updates from the negotiating team on discussions with Greenland's KNAPK and the Faroese Laksaskip

- Fridleifur Gudmundsson, North Atlantic Salmon Fund (Iceland)
- Bill Taylor, Atlantic Salmon Federation
- Chad Pike, North Atlantic Salmon Fund (US), & Orri Fund

**Panel 3: Dams & river-level advocacy** – Updates on two main ecological continuity issues

- Marc Adrien Marcellier, North Atlantic Salmon Fund (France)
- Stephane Fraisse, French National Institute for Agricultural Research
- Gísli Sigurðsson, Árni Magnússon Institute in Iceland

**Panel 4: Regulatory update** – Recent regulatory action and a framework for moving forward, with a focus on regulating aquaculture across the North Atlantic Basin and Canada

- Runar Rugtvedt, Norwegian Federation of Industries
- Dr. Jón Þrándur Stefánsson, Sea Data Center
- Sarah Bayley Slater, Atlantic Salmon Trust (AST)

**Panel 5: Aquaculture** – Update on development of closed-containment systems, the economic case, and looking to the future

- Brian Vinci, Freshwater Institute
- Geir Spiten, AkvaTech
- Rognvaldur Gudmundsson, Akvafuture

**Panel 6: Working together moving forward** – Norway as a model of collaboration between NGO's

- Jens Olav Flekke, Reddvillaksen (NASF Norway)
- Torfinn Evensen, Norske Lakseelver

# Salmon Summit

## Reykjavik, Iceland, 22 March 2018

*Panel 1*

## *Science Update:*

*The State of the Stocks*

*Managing the Challenges*

*New Approaches and New Technologies*


**Jon Carr** — Atlantic Salmon Federation / Fédération du Saumon Atlantique

**Torbjørn Forseth** — NINA, Norwegian Institute for Nature Research

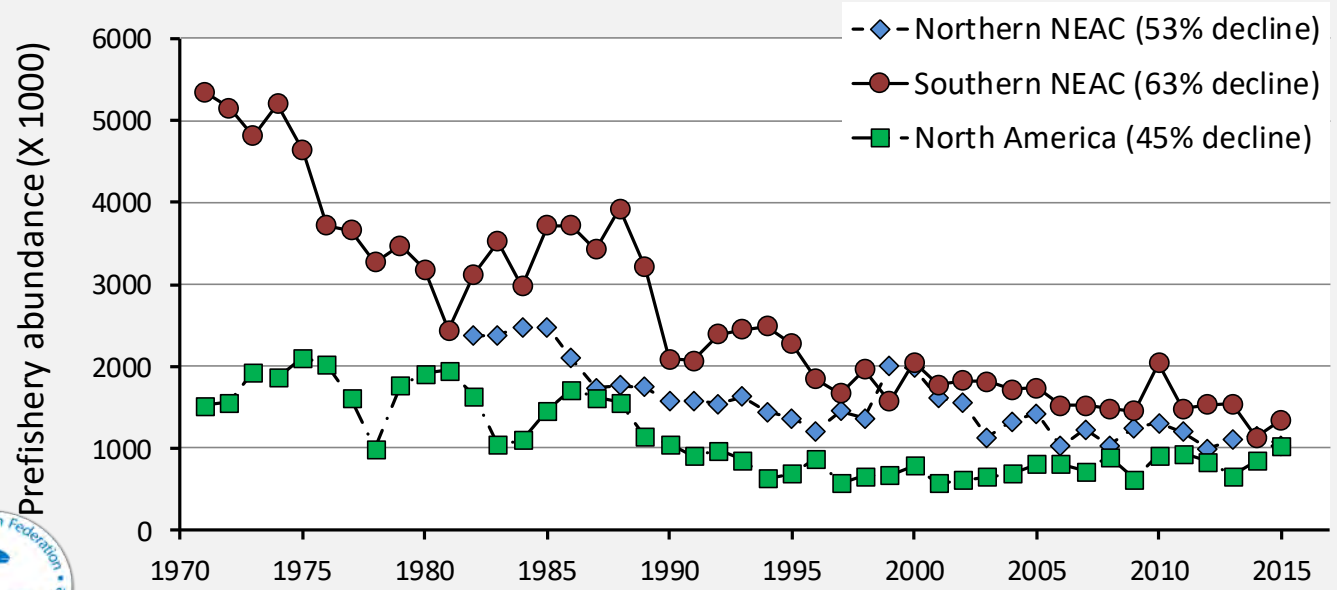
**Ken Whelan** — Atlantic Salmon Trust

# Outline

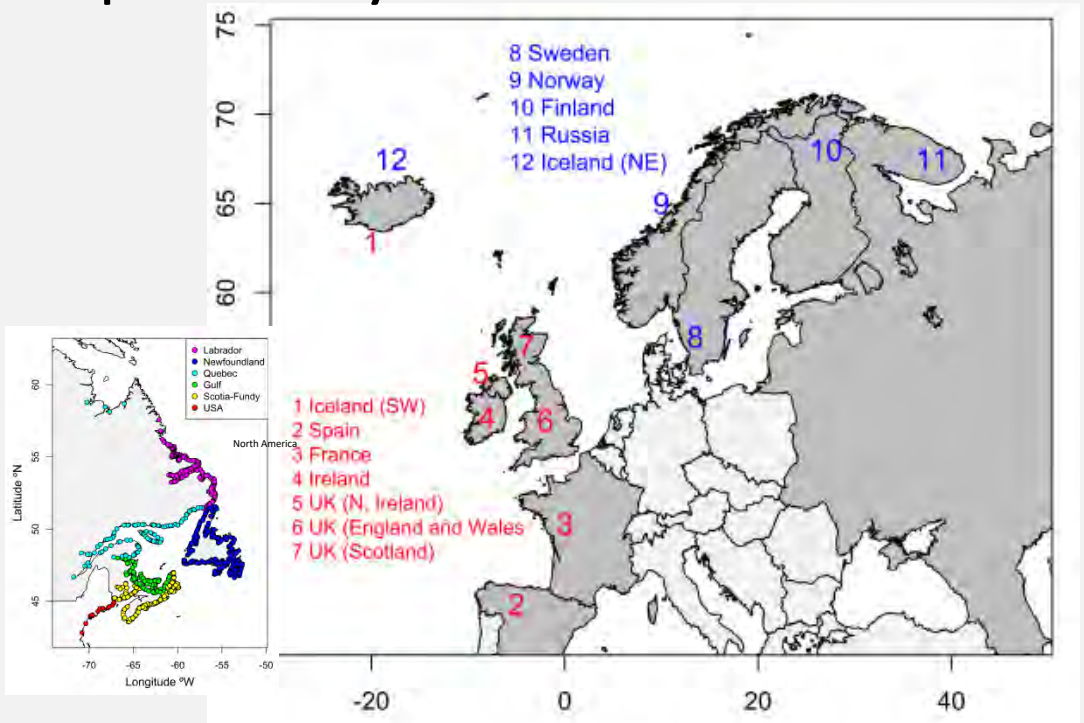
- Status of Atlantic salmon
- Overview of Threats
  - Telemetry as a tool to map spatial and temporal ocean migration
- Status of Norwegian salmon populations
- Aquaculture Threats
- Managing the Challenges
- New Approaches on the Horizon

# Status of Atlantic Salmon

- Atlantic salmon abundance stuck at historic low levels since late 1970s.
- Important declines in estimated pre-fishery abundance (as of Jan. 1 of first winter at sea) of Atlantic salmon in 3 major stock complexes of North Atlantic.
- Peak estimated abundance that likely exceeded 10 million fish at sea in the 1970s to an average less than 3.5 million fish in past ten years.




Courtesy of Gerald Chaput, DFO Canada



# Localised Issues and Threats:
## Local and Region Specific

- Habitat fragmentation and destruction
- Exotic species
- Fish passage limitations
- Chemicals and pollution
- Forestry and agriculture practices
- Aquaculture (genetic, disease, parasites, competition)
- Predator-prey
- Climate change

# Marine Issues and Threats
## Multiple Stocks

- Broad spatial scale shifts in marine ecosystem has affected stocks in NA and Europe.
- Smolt to adult survival has dropped from > 25% to <5%.
- Poor at sea survival is primary driver of species decline across entire range.
- Overfishing, bycatch, prey and predator shifts, temperatures, wind and currents, etc.

***We need to understand the locations, times, scale, and causes of salmon mortality in the ocean phase of salmon life cycle.***

# Filling in the Knowledge Gaps of 'Where' and 'Why' in the Ocean

## *Using Telemetry as a Tool*

**WHERE**

Our telemetry objective is to map spatial and temporal distribution of Atlantic salmon in the marine environment.

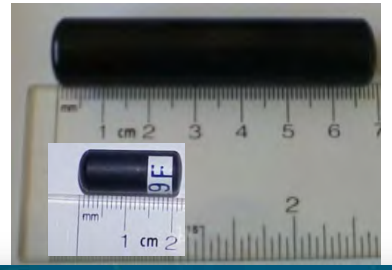
**WHY**

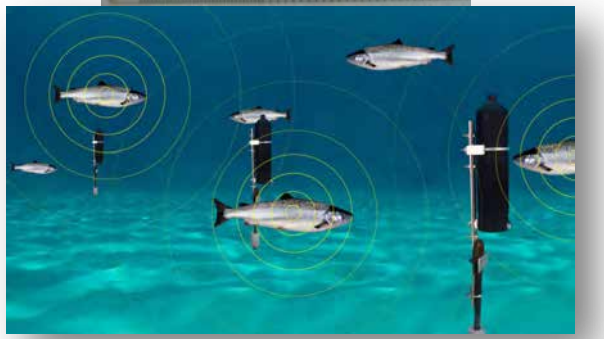
Once the map of 'where' is provided we can begin to link predator, prey, anthropogenic activities, climate driven parameters, and ecosystems in general.

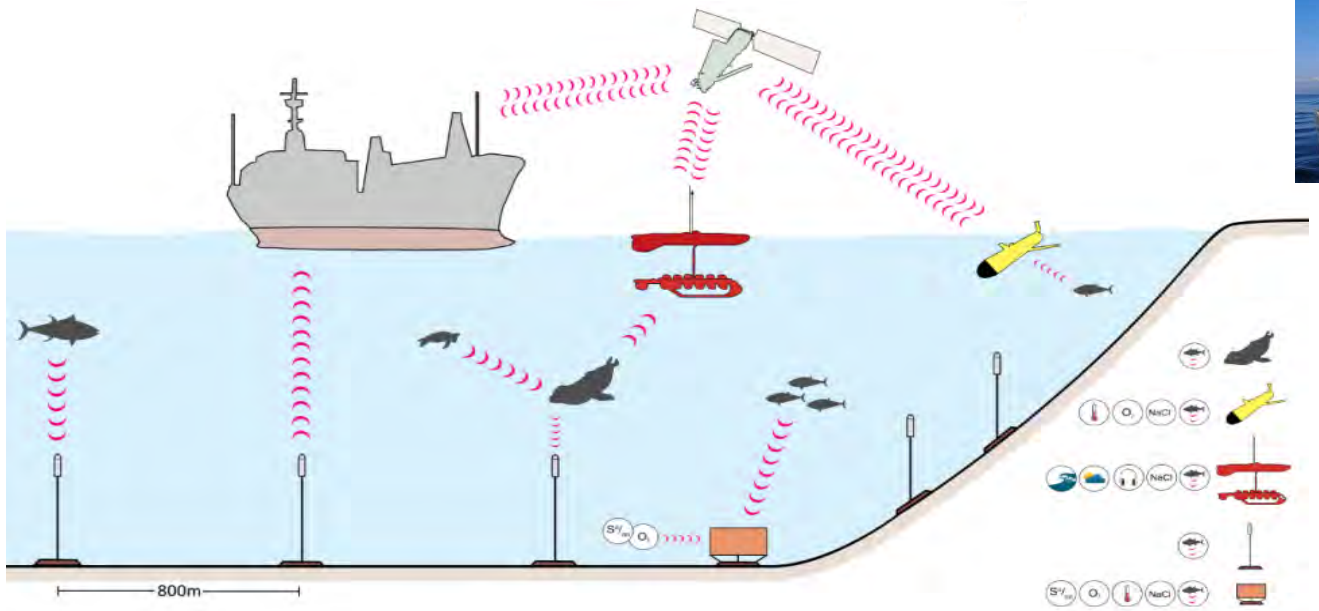
***It's about putting pieces of the jigsaw puzzle together.***

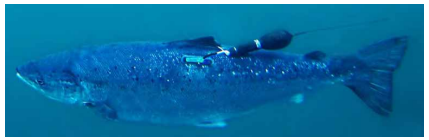
# Telemetry: Why Now?

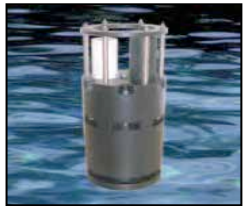
- **Technological advances.**
- **Substantial infrastructure.**
- **Increasing collaborations, new initiatives, & multi-species benefits.**

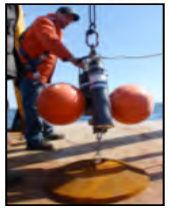




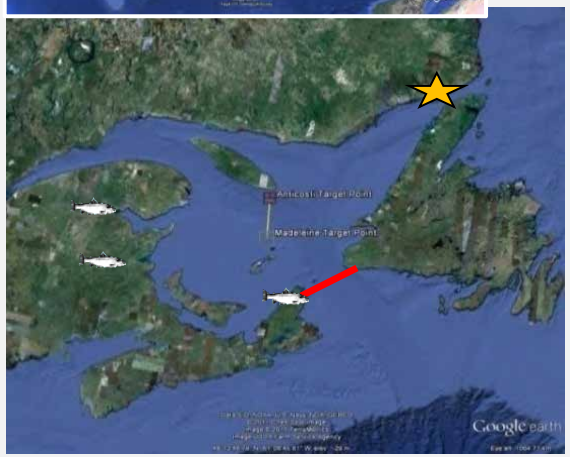






# Telemetry
# What Have We Learned so far?

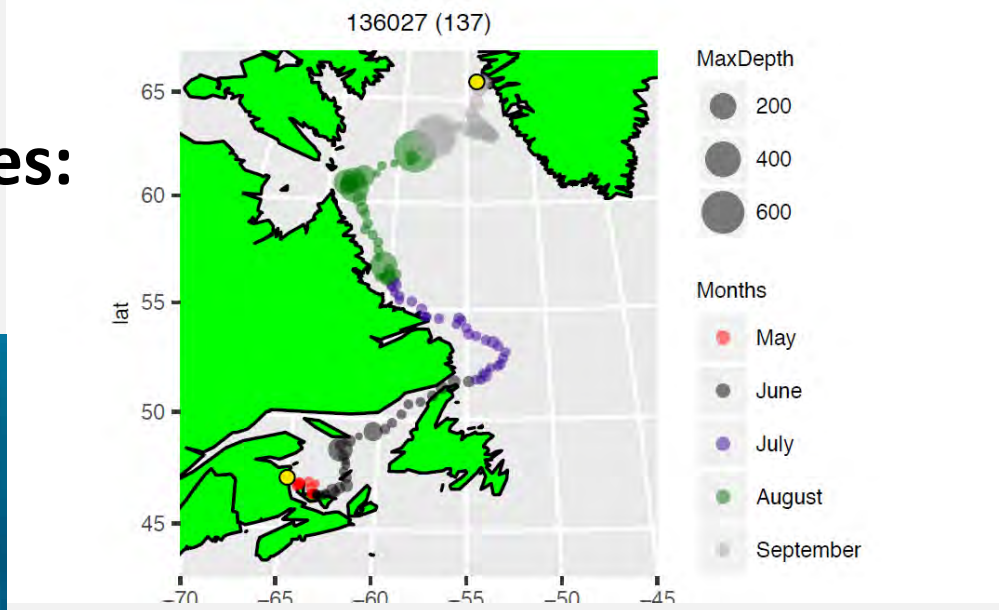




**Narrowed and defined spatial and temporal windows:**

- **Important input data for marine modelers.**
- **Important for localized marine spatial planning.**

**Identifying complex and dynamic migration routes:**

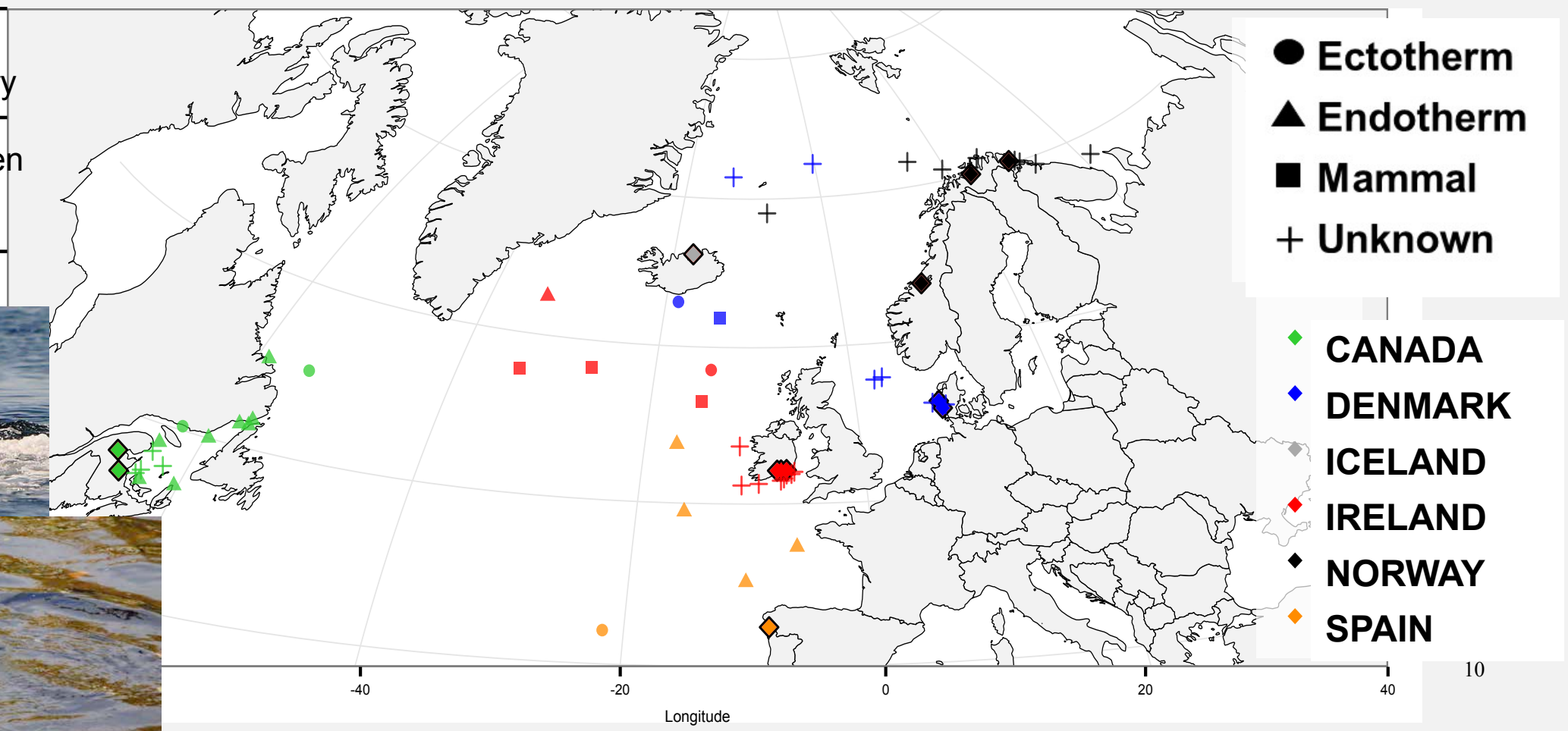
- **Relatively narrow in time and space.**



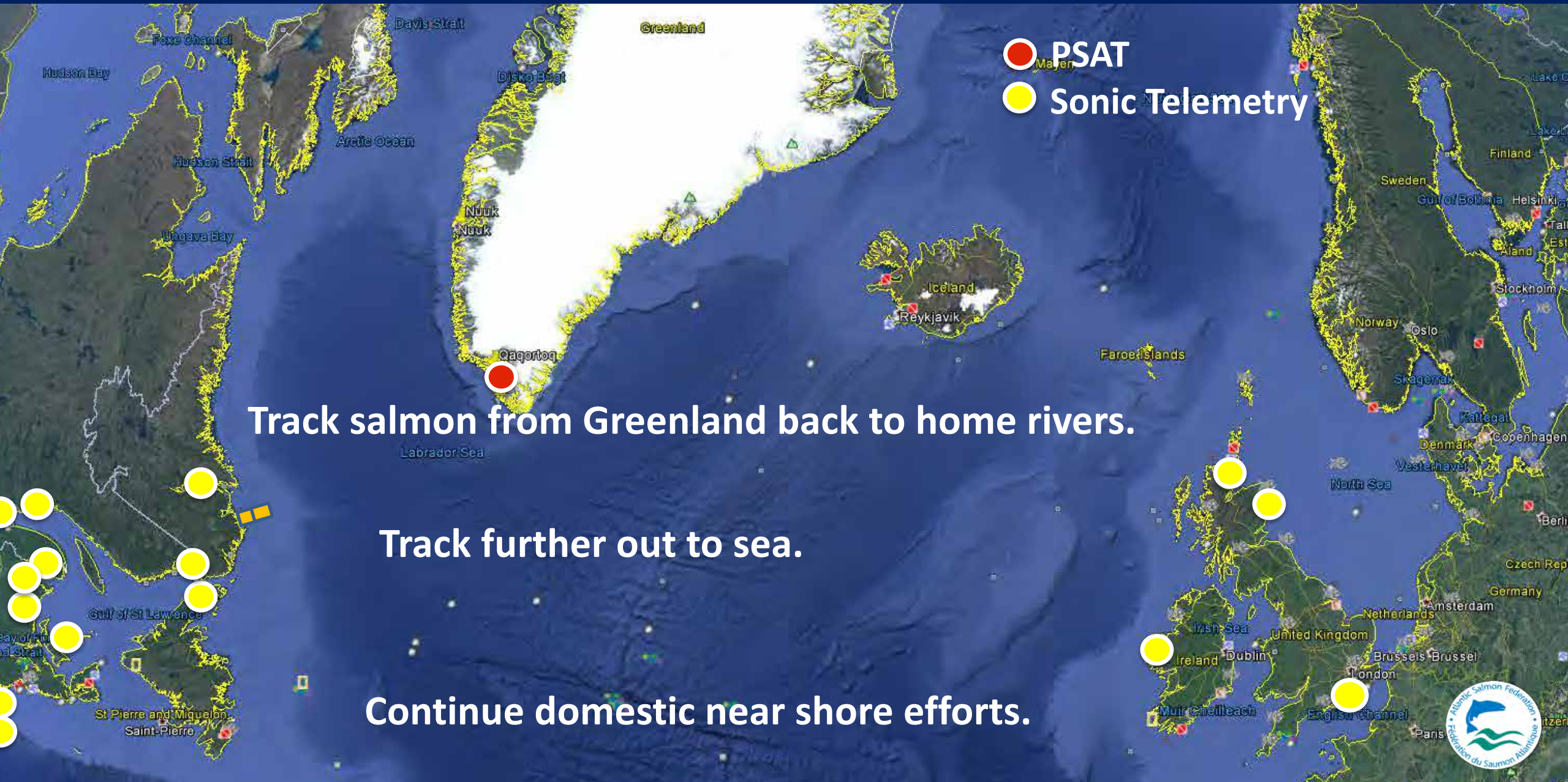

Atlantic Salmon Federation
Fédération du Saumon Atlantique

# Ocean Predation on Atlantic Salmon

**John Fredrik Strøm**
Kim Aarestrup
Henrik Baktoft
Steven Campana
Jonathan Carr
Patrick Gargan
David Righton
Michael Stokesbury
Eva B. Thorstad
Audun H. Rikardsen



# Continue to Explore Spatial and Temporal Distribution



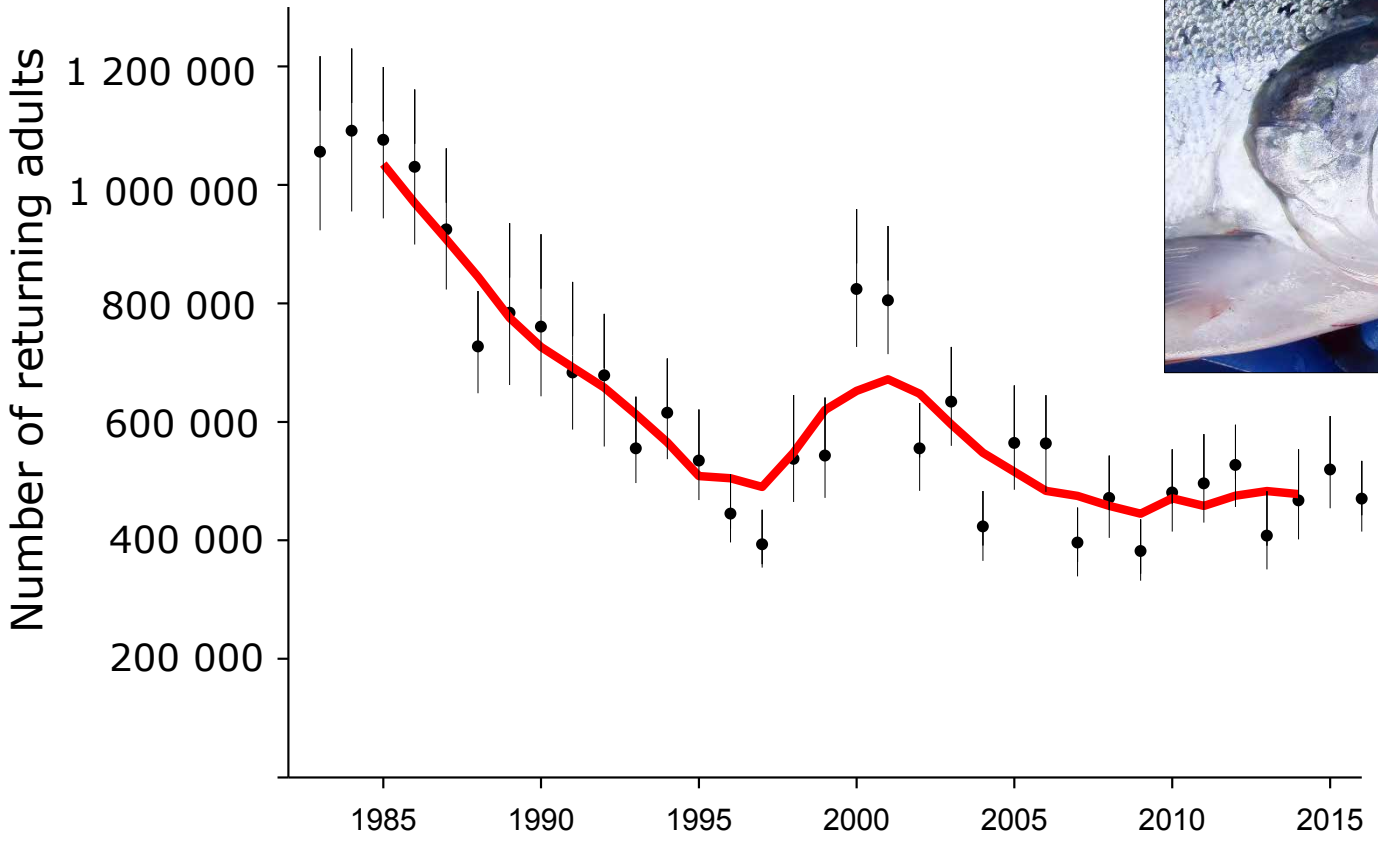
# Population status, trends and threats to wild Atlantic salmon in Norway

Torbjørn Forseth

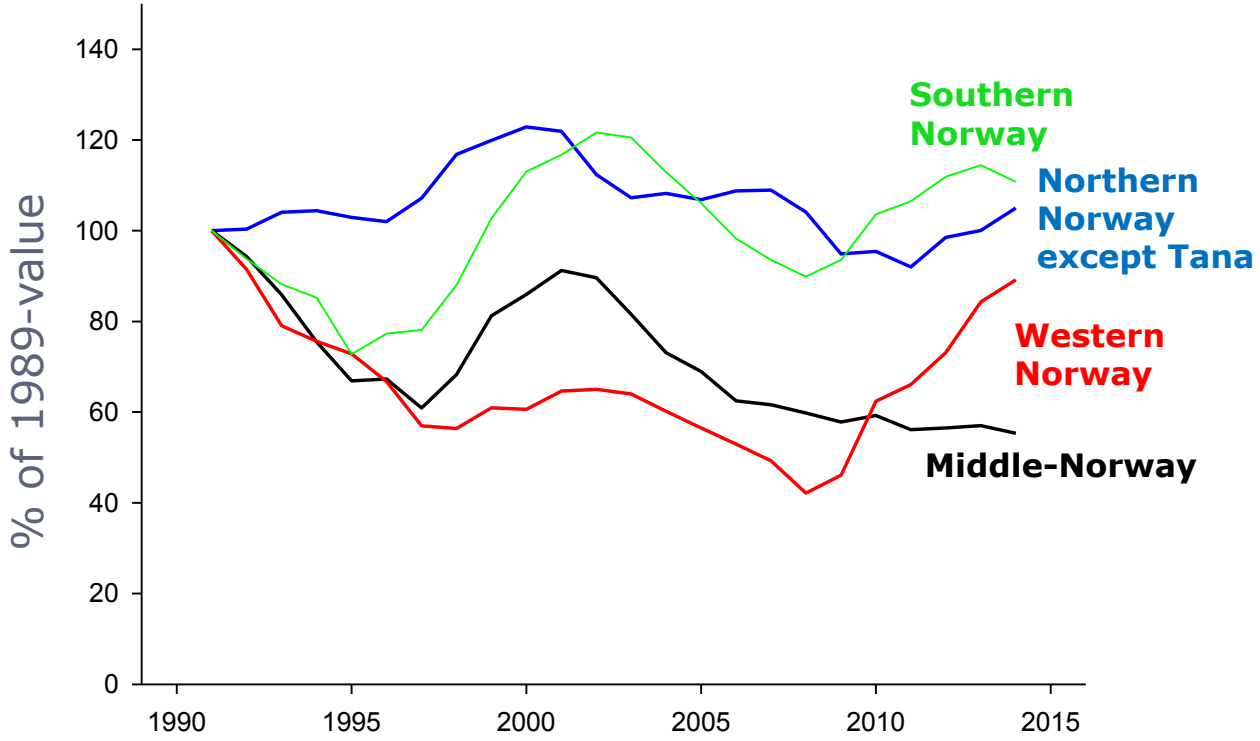
Norwegian Scientific Advisory Committee for Atlantic Salmon

NINA
Norwegian Institute for Nature Research

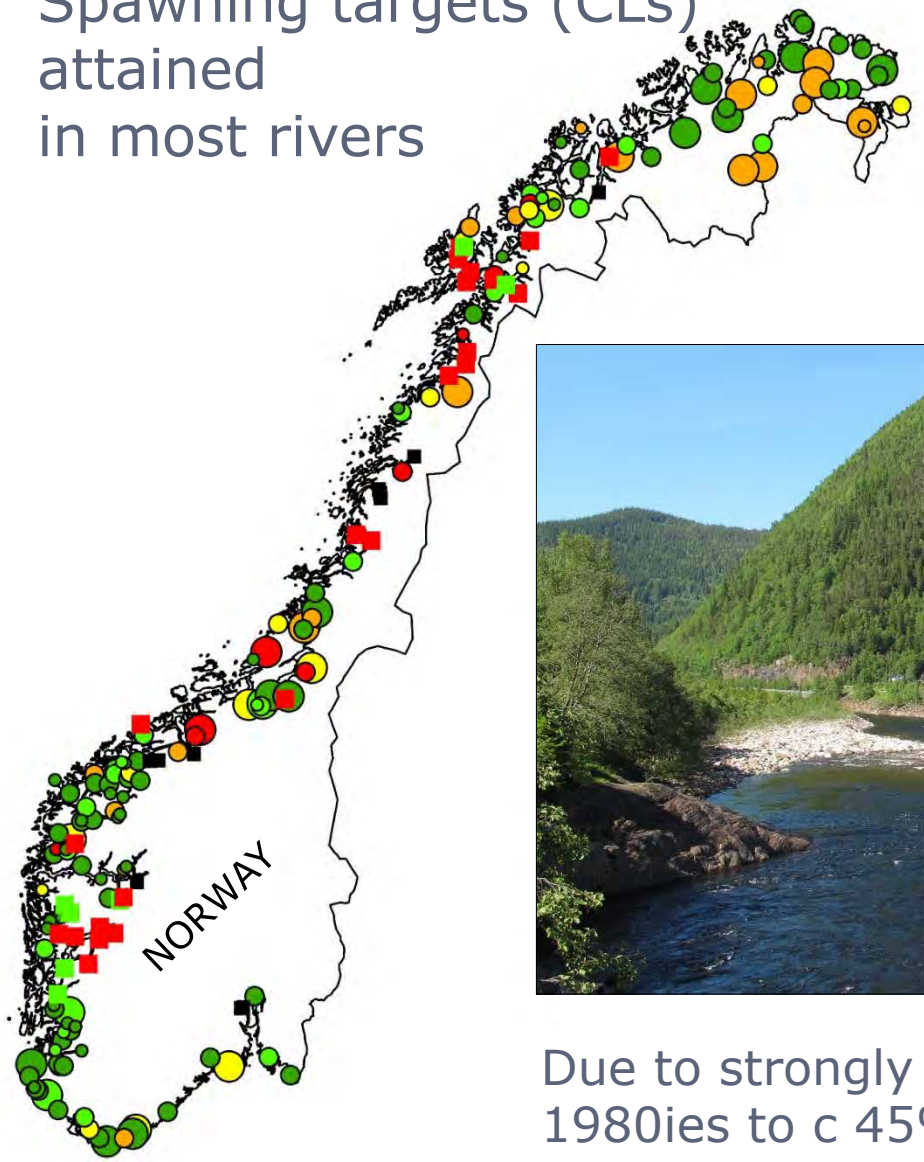
# Pre-fishery abundance of wild Atlantic salmon more than halved since 1983




# Regional differences in trends in pre-fishery abundance

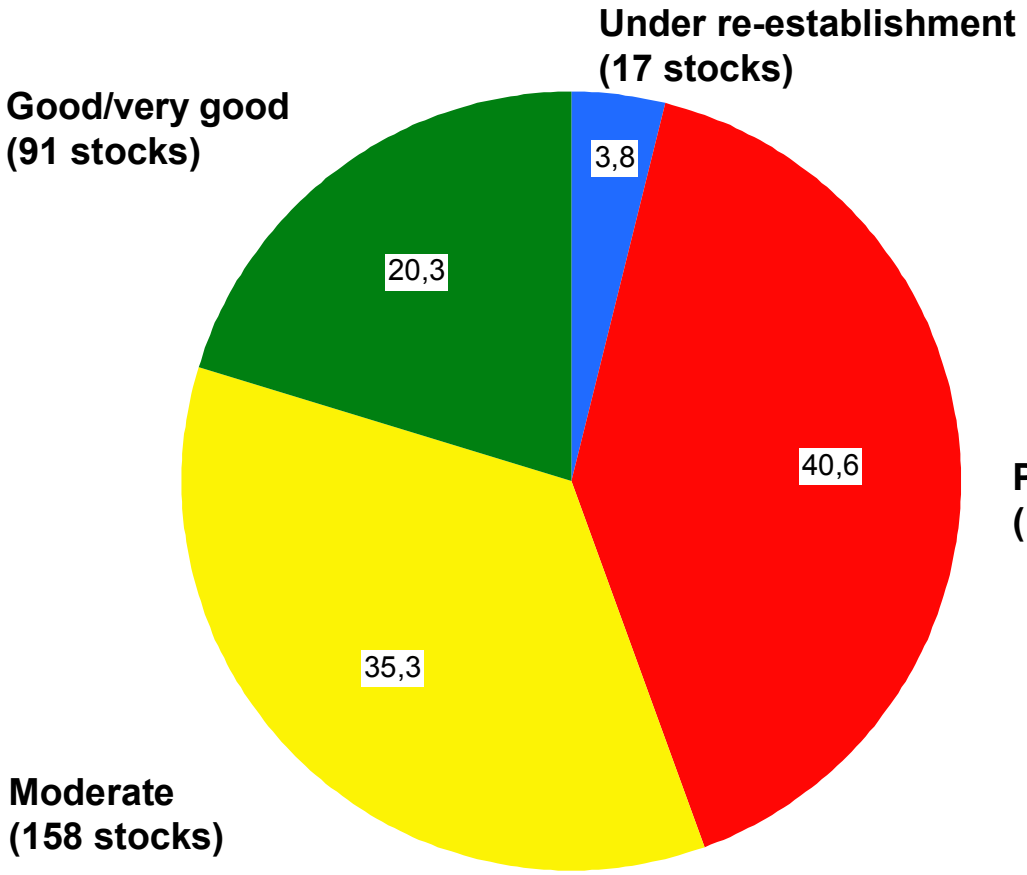



# Spawning targets (CLs) attained in most rivers

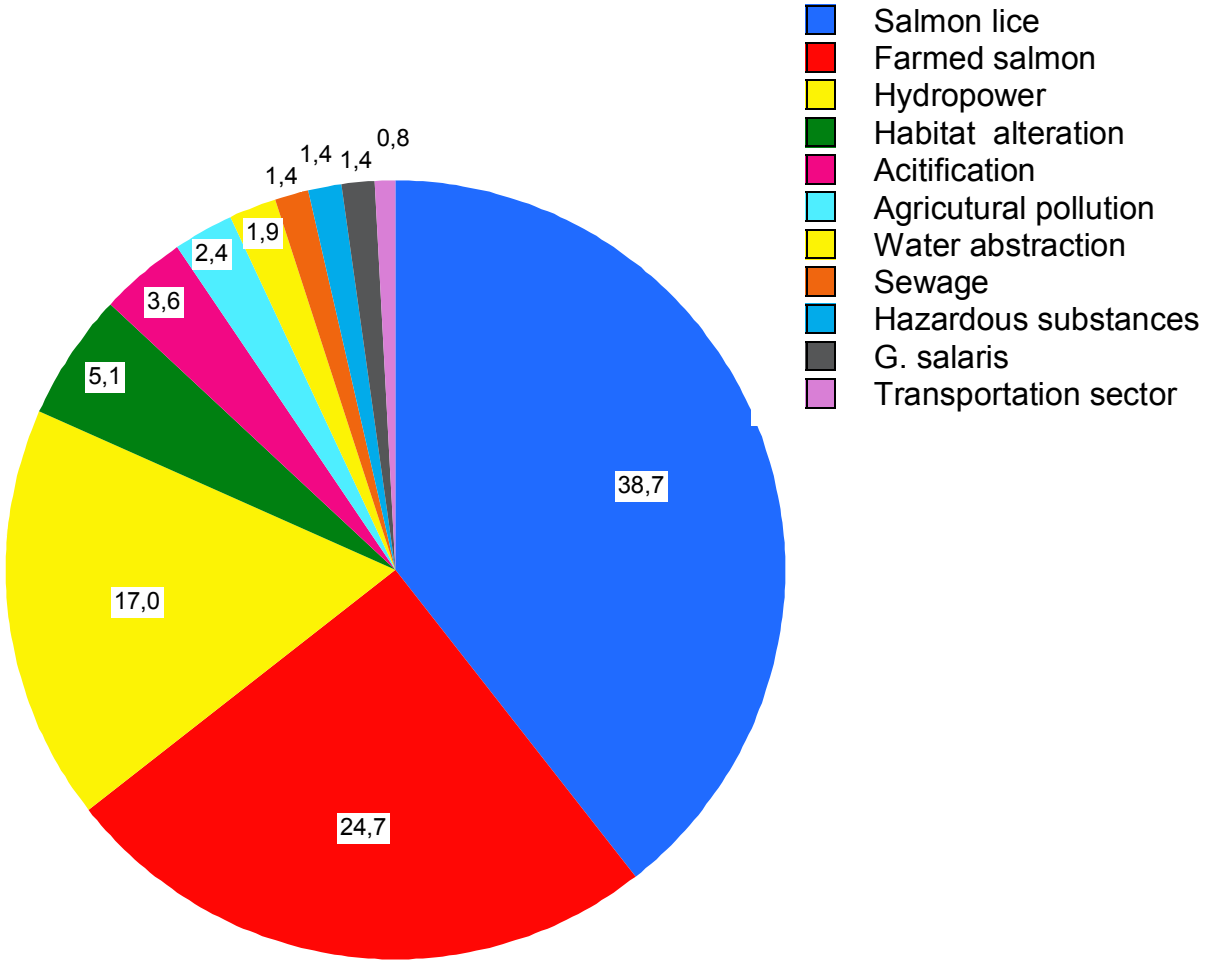



Due to strongly reduced exploitation (>80% in 1980ies to c 45% in recent years)

# Status of all 448 stocks

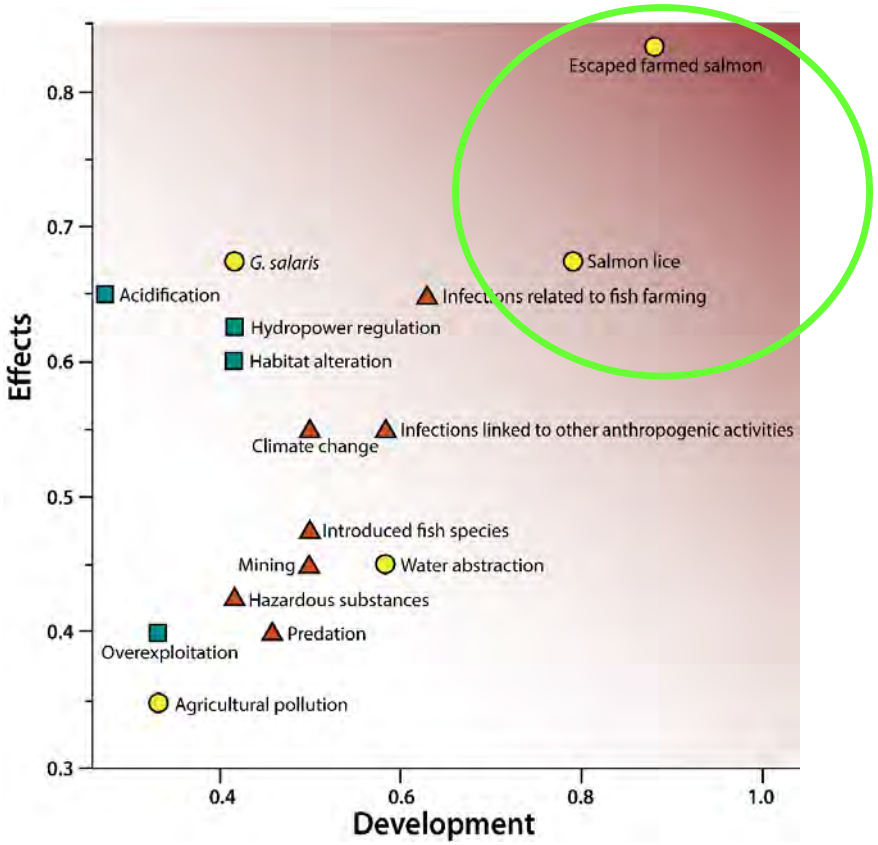



# The anthropogenic factors



# **Escaped farmed salmon** and **salmon lice from fish farms** identified as ongoing and expanding population threats

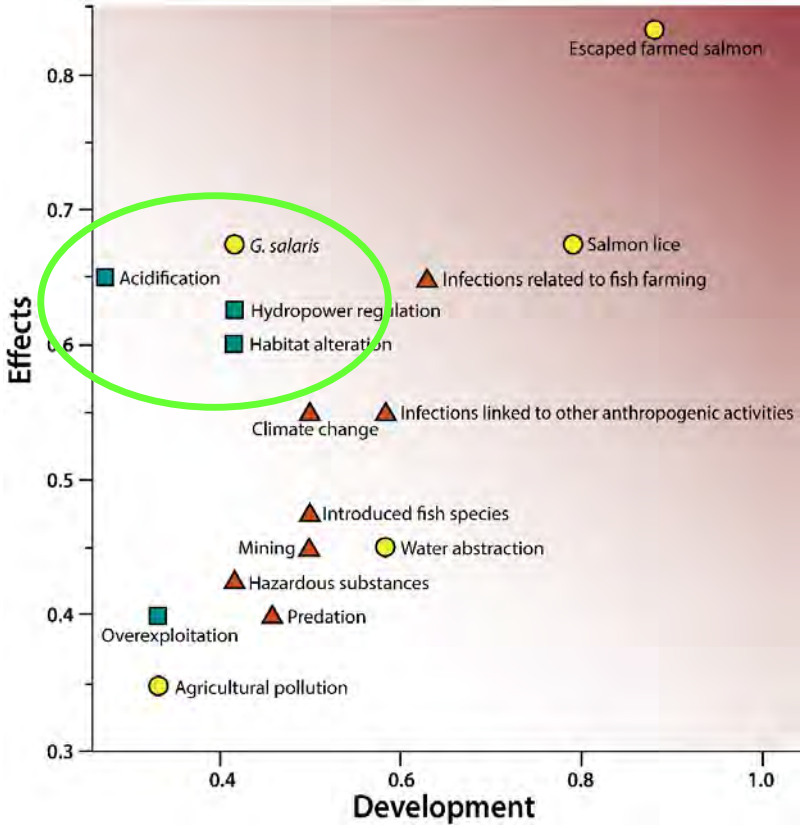
Affect wild salmon populations to the extent that they may be critically endangered or lost




Forseth et al. 2017. The major threats to Atlantic salmon in Norway. ICES Journal of Marine Science, accepted.

# *Gyrodactylus salaris*, acidification, hydropower and other habitat alterations

identified as stabilized population threats



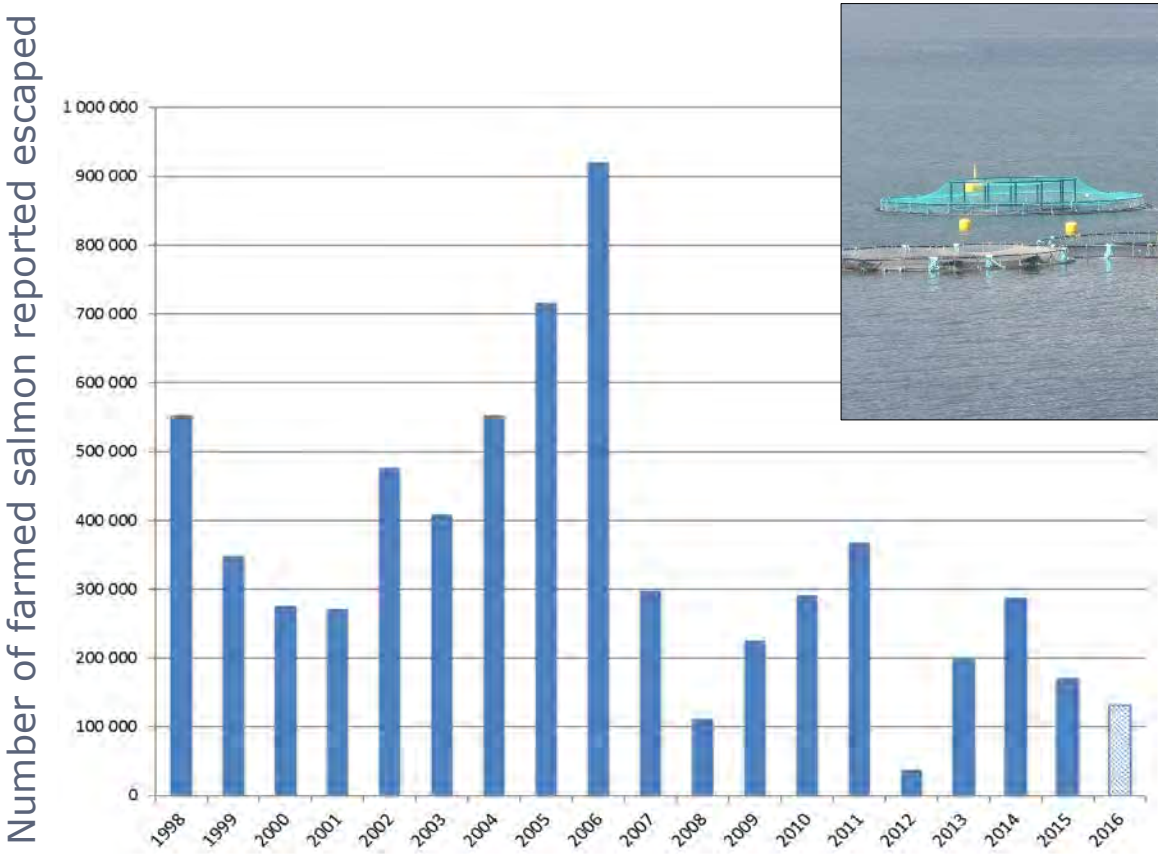

Have contributed to populations becoming critically endangered or lost, but with low probability of causing further loss

Forseth et al. 2017. The major threats to Atlantic salmon in Norway. ICES Journal of Marine Science, accepted.

# Salmon farming – the large numbers problem

- 470 000 adult salmon returned from the ocean to Norwegian rivers for spawning
- One net pen may contain 200 000 farmed salmon
- 385 000 000 farmed salmon in pens (819 times number of wild salmon)

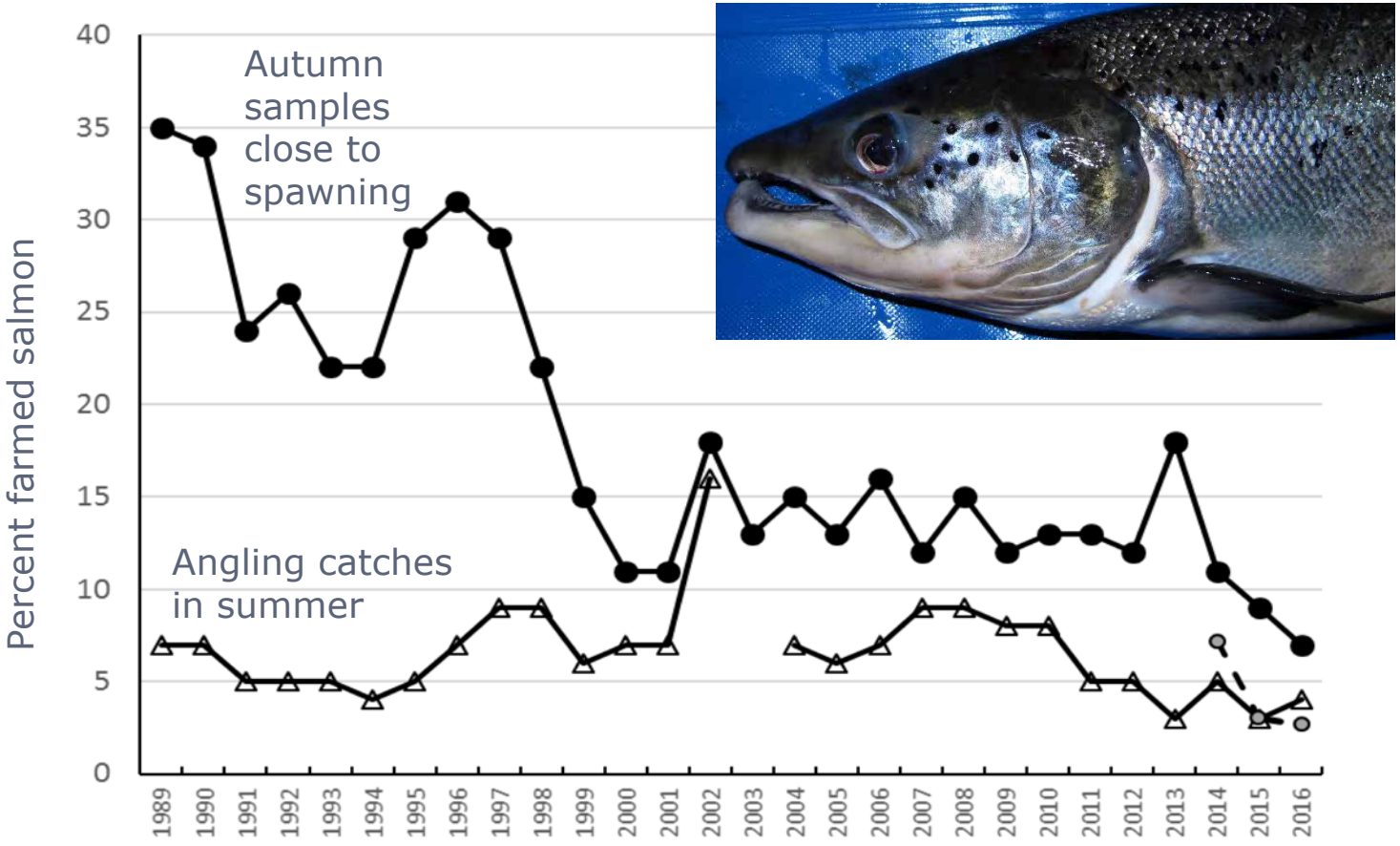
# Official reported number of farmed escapees



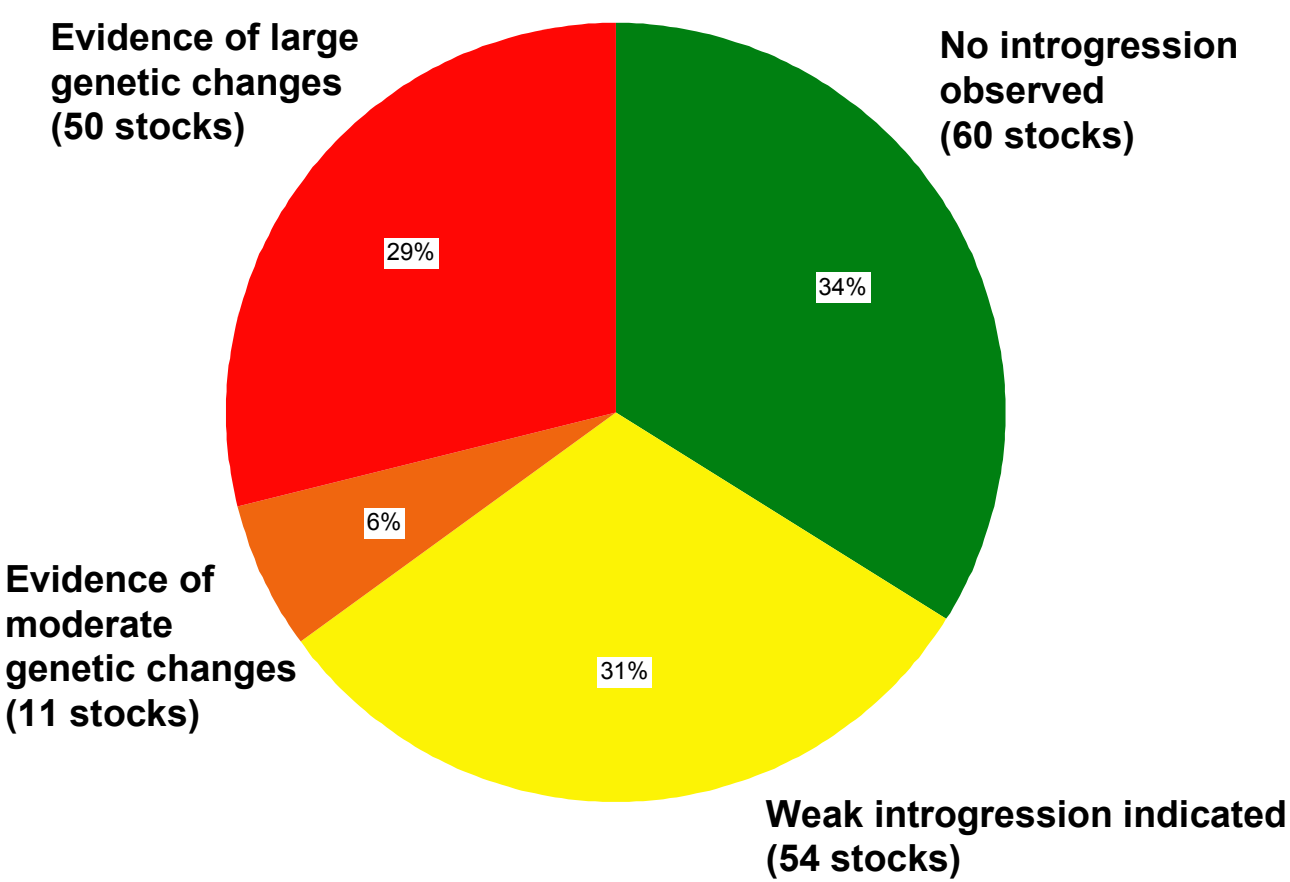

Actual escapes likely 2-4 times higher than reported numbers

based on estimates for 2006-2011 in Skilbrei et al. 2015 ICES J Mar Sci 72:670-685

# Proportion escaped salmon in rivers reduced, but remain too high



# Genetic screening of apparent wild fish from 175 stocks




# Why is genetic introgression of farmed salmon a threat?

Farmed salmon are selected for farm life

Wild salmon are adapted to life in nature and in each river

nature ecology & evolution

ARTICLES

PUBLISHED: 10 APRIL 2017 | VOLUME: 1 | ARTICLE NUMBER: 0124

## Gene flow from domesticated escapes alters the life history of wild Atlantic salmon

Geir H. Bolstad[1*], Kjetil Hindar[1], Grethe Robertsen[1], Bror Jonsson[2], Harald Sægrov[2], Ola H. Diserud[1], Peder Fiske[1], Arne J. Jensen[1], Kurt Urdal[3], Tor F. Næsje[1], Bjørn T. Barlaup[4], Bjørn Florø-Larsen[5], Håvard Lo[5], Eero Niemelä[6] and Sten Karlsson[1]

**Interbreeding between domesticated and wild animals occurs in several species. This gene flow has long been anticipated to induce genetic changes in life-history traits or wild populations, thereby influencing population dynamics and viability. Here, we show that individuals with high levels of introgression (domesticated ancestry) have altered age and size at maturation in 62 wild Atlantic salmon *Salmo salar* populations, including seven ancestral populations to breeding lines of the domesticated salmon. This study documents widespread changes to life-history traits in wild animal populations following gene flow from selectively bred, domesticated conspecifics. The continued high abundance of escaped, domesticated Atlantic salmon thus threatens wild Atlantic salmon populations by inducing genetic changes in fitness-related traits. Our results represent key evidence and a timely warning concerning the potential ecological impacts of the globally increasing use of domesticated animals.**

Gene flow from domesticated animals into wild conspecific populations is widespread, and documented examples include American mink[1], wolves[2], wild boars[3], wild cats[4], bisons[5] and Atlantic salmon[6,7]. Domestication commonly entails selection for economically important traits and genetic homogenization due to low effective population sizes[8]. Domesticated organisms have therefore altered the genetic composition underlying functional traits, and theoretical models predict that gene flow from domesticated organisms into wild populations is detrimental for population growth and stability[9,10]. In plants, the effects of hybridization between domesticated and wild conspecifics include evolution of weeds, increased or new invasiveness, and increased risk of extinction for wild species[11]. In animals, experimental studies have documented genetic differentiation in phenotypic traits between domesticated organisms and their wild conspecifics, with hybrids often at intermediate values. The animal literature is dominated by studies on salmonid fishes, and particularly on Atlantic salmon.

The domestication process of the Atlantic salmon in Norway involved a large-scale national breeding programme beginning in the 1970s, based on several wild populations from Norway, with selection on increased growth and avoidance of early sexual maturation[12,13]. Later, the breeding goal included other traits such as disease resistance, flesh colour and fat content[12–14]. Common garden experiments show that domesticated salmon and hybrids have altered phenotypes, compared with wild salmon. This includes growth[15–18], predator avoidance and aggression[19], life-history traits and phenology[20], and probability of precocious male maturation[15,21]. Three large-scale experiments using different rivers controlled by fish traps showed that domesticated introgression can alter the age at seaward migration (smolt age) and the sea age at maturity, and lead to reduced survival and reproductive fitness[22–24]. This literature leaves little doubt that domesticated introgression is expected to impact the wild Atlantic salmon in a way that is most probably detrimental to population demography. However, the experimental settings and limited number of whole-river experiments do not necessarily represent the extent or scale of the impact of domesticated introgression on natural populations.

The effects of introgression on life-history traits, such as age and size at maturation, are of particular concern because of their close connection to fitness and demography[25]. In Atlantic salmon, the time spent at sea before maturation, called sea age, is closely related to their size at maturity[26,27]. An Atlantic salmon returning to the river to spawn after three winters at sea is 3–5 times heavier than one returning after one winter. Because size is strongly related to reproductive success[28] and the survival at sea is low[29], the sea age at maturity represents a trade-off between survival and reproductive success. In addition, the growth rate at sea affects both adult size (and therefore reproductive success) and survival[30]. There may also be complex relations between early and late life-history decisions, for example precocious male maturation (or parr maturation) leads to investment in gonad production over somatic growth and a postponed seaward migration[31,32].

Interbreeding between domesticated and wild Atlantic salmon occurs in many parts of its natural range on both sides of the Atlantic[22–24]. Fish farms are common from Ireland and Scotland to the Russian coast of the Barents Sea and from Maine in the United States to Newfoundland in Canada. We investigated the effects of gene flow from domesticated salmon in 62 populations along the entire Norwegian coastline (Fig. 1a). Norway has both the world's largest Atlantic salmon farming industry and the largest remaining wild population[33]. The number of farmed escapees is estimated at approximately one million fish annually[34]. This is more than the total number of fish in the Norwegian salmon run[35], and has led to extensive gene flow from domesticated to wild fish[22].

### Results

**Eastern Atlantic phylogenetic group.** The Norwegian domesticated Atlantic salmon originate from populations along the west

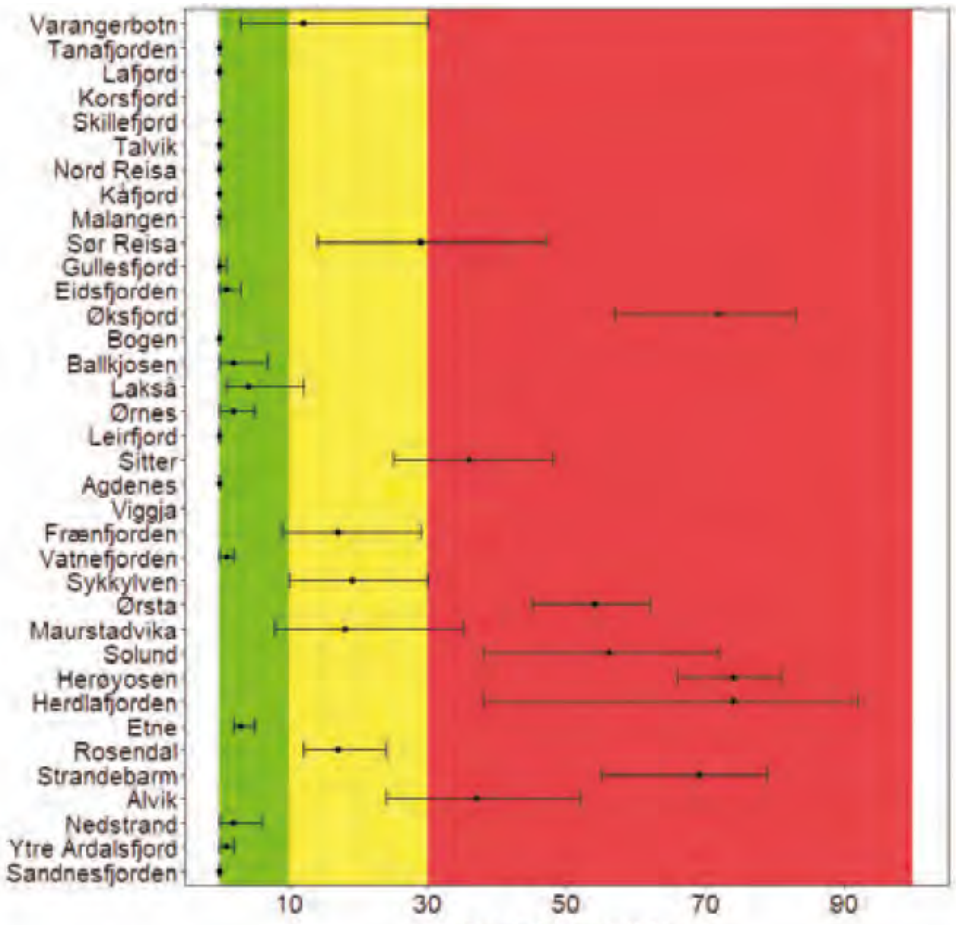
[1]Norwegian Institute for Nature Research (NINA), NO-7485 Trondheim, Norway. [2]Norwegian Institute for Nature Research (NINA), NO-0349 Oslo, Norway. [3]Salgrupanda Biologer, NO-5003 Bergen, Norway. [4]Uni Research, NO-5006 Bergen, Norway. [5]Norwegian Veterinary Institute, NO-7485 Trondheim, Norway. [6]Natural Resources Institute Finland, FI-90014 Oulu, Finland. *e-mail: geir.bolstad@nina.no

NATURE ECOLOGY & EVOLUTION 1, 0124 (2017) | DOI: 10.1038/s41559-017-0124 | www.nature.com/natecolevol

# Salmon lice

- Several release experiments with protected and unprotected smolts have shown effects on growth, age at maturity and survival
- Meta-analyses of experiments show 12 to 29% additional mortality
- Recent analyses indicate an annual loss of 50 000 adults returns to Norwegian rivers during 2010-2014

# The 2017 risk assessment report (IMR)




Estimated smolt mortality (%)

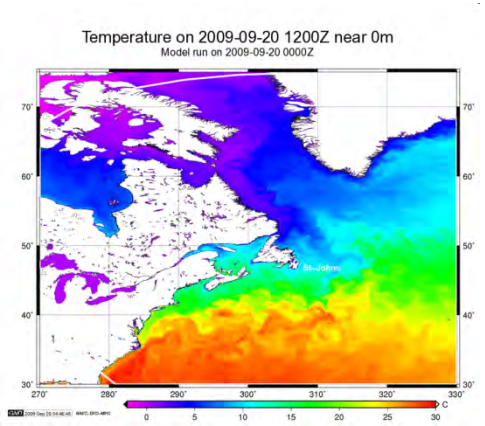
*North Atlantic Salmon Fund – The Orri Fund*
*Salmon Summit*
**Reykjavik, Iceland, March 21st – 22nd , 2018**

# *Integrating the approaches and managing the challenges*


## Ken Whelan, Atlantic Salmon Trust

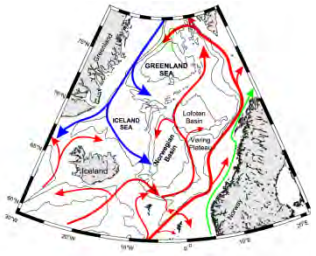

# What has caused such an unprecedented decline?

- Over Fishing ?
- Habitat Destruction ?
- Barriers ?
- Drop in Water Quality ?
- Increase in Predators ?
- Aquaculture ?
- Relative importance of these impacts will vary.
- Warming oceans and warming freshwaters ?
- Impacts at x4 scales: local, national, regional and transnational



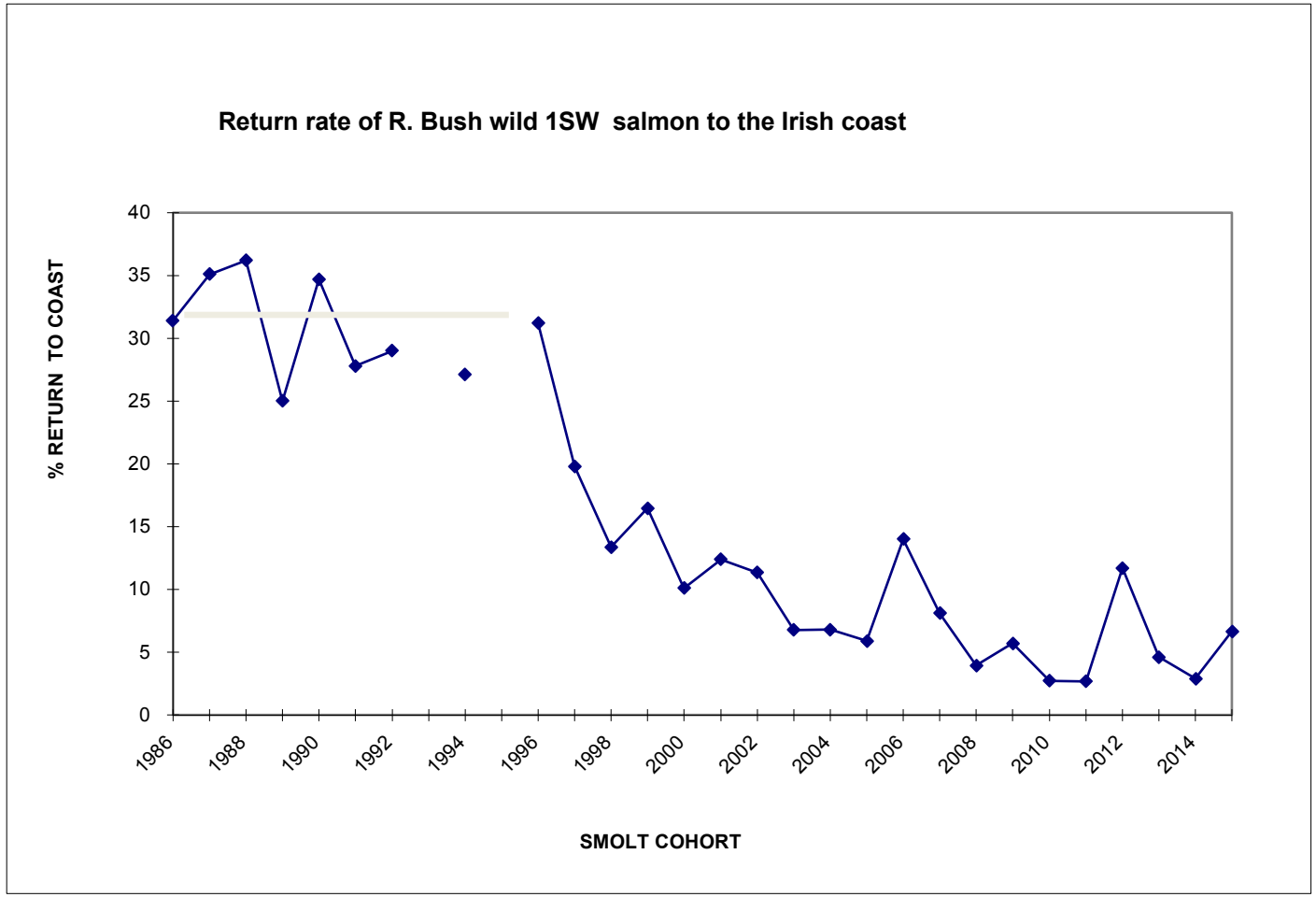
# What has been achieved?

- High seas and near shore netting – greatly reduced
- Improved water quality
- Habitat protection and restoration
- Increasingly better management of aquaculture impacts…(still a way to go to reverse the damage!)
- But ….salmon populations are not responding ?
- Marine survival at stubbornly low levels – dropped from 25%+ to 5% !
- WHY???
- Where do we focus our research and management funding ?



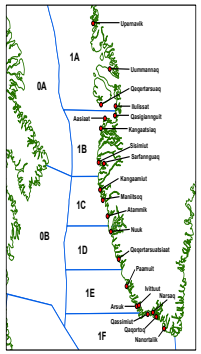

# The Scale of the Problem 2015: River Bush

Complex !! - but how can research be targeted and prioritised?



# The Likely Suspects Framework Concept

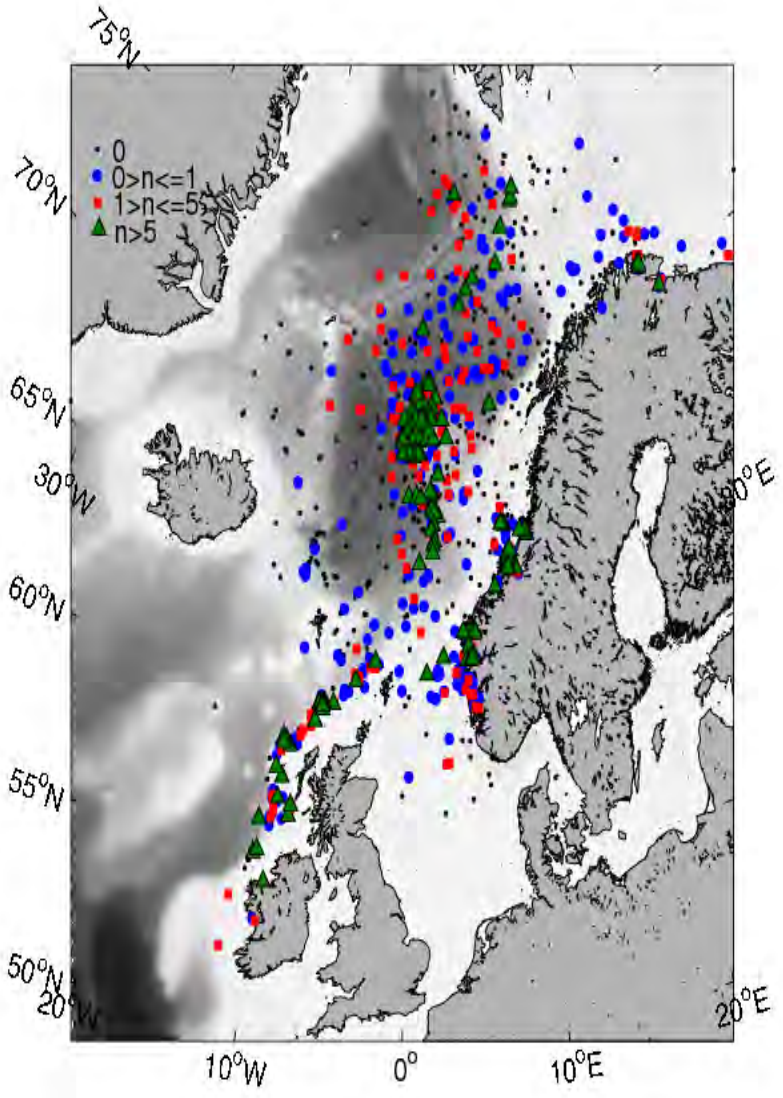
- This approach places **candidate mortality factors** within an overall spatio/temporal Framework, covering the freshwater migration phase and the marine phase.
- The overall objective is to quantify the potential of each factor to influence survival (the **“likely suspects”**).
- Identify the likely impact both individually and cumulatively of the “suspects”…..an exercise in accounting.
- A key objective is to target research and through this, <u>refine</u> the initial estimates of the potential scale (or range) of mortality at each part of the Framework= **partitioning mortality at sea** (as in SALSEA Track)
- Can we narrow this down to the really important “suspects” and decide what to do about it?
- A particular focus would be on identifying **where and how mortality factors had changed** between earlier periods of higher marine survival and the more recent/current low survival phase – why up to 25% marine survival in the 1970s?



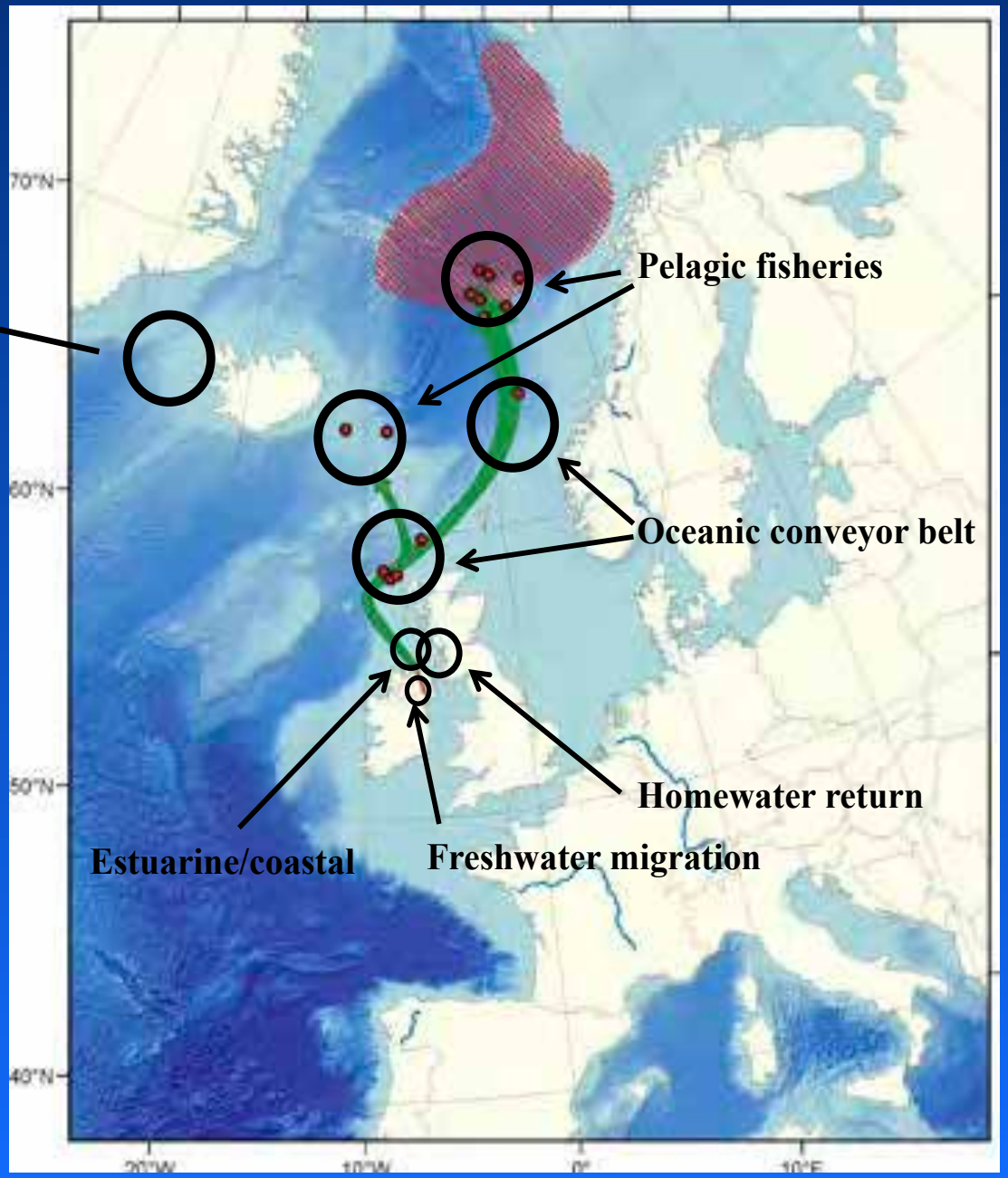
## Likely Suspects Framework – where does the mortality take place?

- There is evidence for where salmon migrate to, and for the existence of numerous mortality candidates.
- Start by identifying the main potential locations/times of mortality and make them **"ecosystem domains"** in the Framework
- Domains can be placed at geographical locations that we suspect may be significant in the various phases of the life cycle.
- Domains are not by any means all in the marine!
- The freshwater migration phase influences subsequent survival at sea.

**Salmon post-smolt captures, from SALSEA**

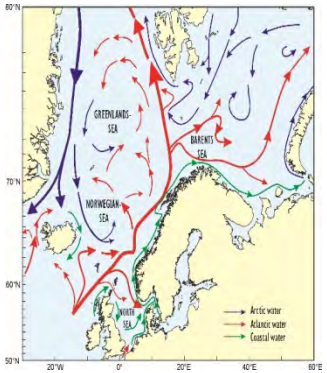


# The Domain Concept



# Likely Suspects Framework – 2018: constructing the Framework

- There will potentially be quite a few **domains**, reflecting areas where **salmon pass through** on their journey from pre-smolt to returning adult:
  - Parr to smolt transformation
  - Smolt migration from freshwater and through estuaries
  - Estuary/sea interface and early marine life (coastal/near shore)
  - Migration pathways to oceanic feeding grounds
  - Overwintering/feeding areas
  - Return migration and entry to home waters and home river




- **Some domains may occupy large areas** of ocean where many stocks coalesce and face similar pressures, while **others will be very localised** where perhaps one or a few stocks pass through and hence the pressures impact fewer stocks
- The **Framework can work at various scales**, from stock complex (= transnational management units) to individual stocks- Europe and N America.

# The Likely Suspects Framework Balance Sheet

**What it might look like!**

- UK Pre-Fishery Abundance: avg. 1971 to 1975: 1.061m
- Pre-Fishery Abundance: avg. 20012 to 2016: 495k
- Fish to account for: 566k

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- Nearshore: Estuarine, Coastal, Homewater Mortalities: 244k
  (seals ,sea lice, avian predation etc)
- Conveyor Belt Mortality: 266k
- Pelagic by-catch 56k
  (eDNA – SeaSalar )

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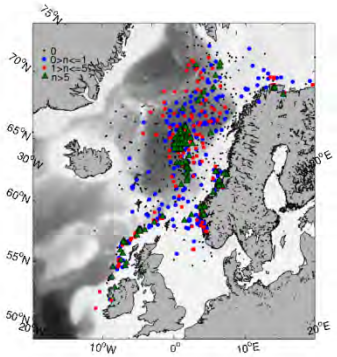
- Tackle *Nearshore* and *Pelagic*, …. you tackle 53% of the marine "suspects"!

# AST Likely Suspects Framework Workshop – Edinburgh, November ‘17

# Suspects Framework – next steps and timelines

- **March 2018-** Set up online operating Framework between Atlantic and Pacific. Co-ordinating and sharing information on research bids and funding opportunities
- **April 2018**- Publish AST "Blue Book" on the Likely Suspects Framework
- **April 2018** - Review of progress/endorsement by ICES WGNAS
- **June 2018** - Report progress to NASCO International Atlantic Salmon Research Board
- **Ongoing** - Develop collaborative research funding bid(s) for an EU Concerted Action-type project or similar science support mechanism – Galway Agreement North America and EU



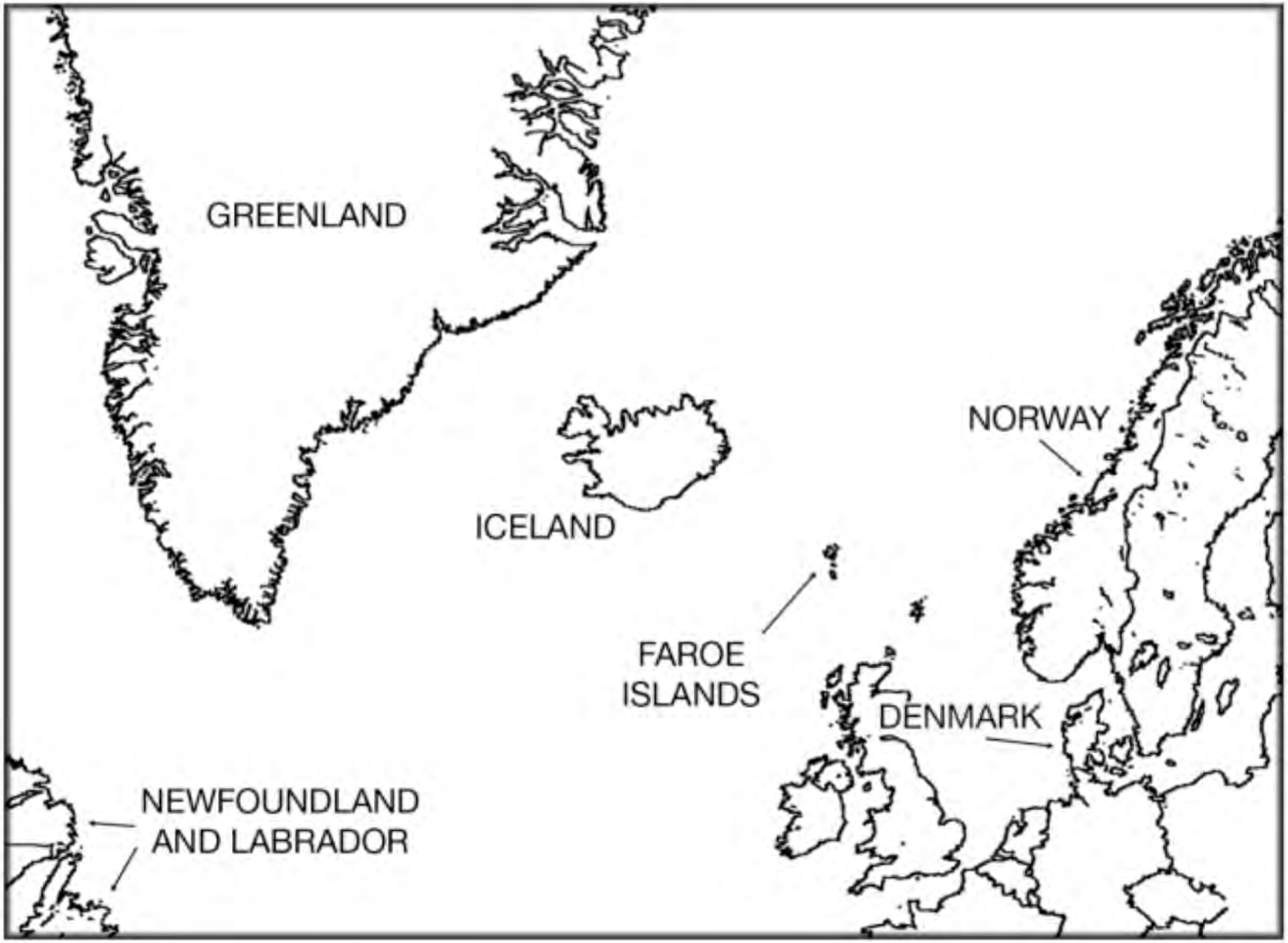

# North Atlantic Salmon Fund

# &

# Felagid Laksaskip

# Agreement from 1991

March 22nd 2018


GREENLAND
ICELAND
NORWAY
FAROE
ISLANDS
DENMARK
NEWFOUNDLAND
AND LABRADOR

# Mixed stock fisheries in Faroese Islands

**The Faroese Economic Zone**

- Historically the Faroese have fished commercially for salmon in mixed stocked fisheries.
- Mix stock fisheries is salmon originating from a variety of European and North American rivers that migrate to the Faroese economic zone and were fished by Faroese fishermen mainly by long lining.
- With knowledge that salmon from all these different places was feeding in the fisheries it made sense to stop the fishing and increase chance of successful salmon runs in many countries at once.
- The best way to accomplish this was simply to buy the quota from the fisherman at market rates.
- This one of the fundamental theories that the North Atlantic Salmon Fund is based on.

# History of the Agreement between Laksaskip and NASF

**The beginning**

- In the 1980´s and early 1990´s there was considerable issuese related to harvesting wild salmon stocks bewteen Iceland and the Faroese.
- Faroese fishermen had fished commercially in the Faroese mixed stock fisheris for decades. With declining numbers in salmon in the North Atlantic something had to be done.
- In 1991 Orri Vigfusson founded the Committee for the Purchase of Open Sea Quotas, which later became the North Atlantic Salmon Fund.
- Felagid Laksaskip is a Faroese Salmon Fishermen Association that the right to receive issued quota from the home rule government.
- In April in 1991 NASF and Felagid Laskaskip signed an agreement regarding that NASF would buy all salmon quota from Laksaskip based on a percentage of the assessed land value of salmon.
- The goverments of both nations endorsed this agreement and the Faorese goverment agreed not to issue licenses for offshor fishing of salmon in the Faroese.
- The agreement has been hounerd every year since 1991.

# Key milestones & development

**Key Milestones**

- In the agreement from 1991 the emphasize was on compensating fair price to fisherman.
- All subsequent agreements have been based on the original agreement from 1991. If the parties reach an agreement annually the 1991 Agreement remains in full effect.
- In 2005 there was an addition to the agreement that entailed that the funds received by Laksaskip should be partially used for joint development programme for funding new business or and/or new employment opportunities for Laksaskip members.
- Both parties agreed that jointly they would work on econcomic development goals and carry out reserch to identify activities that could replace salmon fishing.
- These goals have been: Fishing for other species, providing new or refubished fishing gear, test fishing, imorved crew accommodation, fish handling improvements and adapting new gear and techniques to emerging fishing opertunities.

# Future of NASF and Faroese Agreement

**Negotiation with Felagid Laksaskip are underway**

- With the passing of Orri Vigfusson in 2017 uncertainty has arisen regarding the future of NASF agreements including the Faroese Agreement.
- A newly formed NASF steering committee is taking over the control of NASF Internatonal.
- NASF Iceland was incorporated in accordance with Orri´s vision in 2017.
- Fridleifur Gudmundsson is chairman of NASF Iceland with board members, Elvar Fridriksson and Gisli Sigurdsson
- NASF Iceland together with the Atlantic Salmon Federation, led by Bill Taylor, are currently negotiating with Felagid Laksaskip in the Faroese.
- A draft agreement has been sent to Laksaskip based on the Agreement from 1991.
- If an agreement will be reached the agreement from 1991 will remain in full effect and the relationship will be intact.
- Similar agreement is being negotiated by the same team with Greenland fisherman assosciation.

# NASF philosophy

**NASF philosophy has always been very clear**

- NASF recognizes the full sovereign rights of nations.
- NASF recognizes the rights of commercial fisherman.
- NASF recognizes their right to make commercial agreements that reflect their fair share.
- This philosophy has enabled NASF to secure that salmon stocks in mixed stock fisheries in areas such as the Faroese economic zone, are in no danger of being harvested, regardless of changes in political landscape or a shift in policy by international organizations or scientific consultation.
- On this basis Orri Vigfusson operated the North Atlantic Salmon funds for 27 years.
- On this basis the NASF steering committee and NASF Iceland will continue to work to enhance salmon stock number wherever they can be found.

# Thank you


the CRRI fund
Help preserve a legacy. Help save the wild North Atlantic salmon.


# Orri Vigfússon

1942 – 2017

"Saviour of the Atlantic salmon,"
*The Times*, July 4, 2017

"For the last 3 decades this award-winning entrepreneur and environmentalist has brought about monumental change."

*Fish and Fly Magazine*, July 2017

Orri Vigfusson, an entrepreneur and life-long outdoorsman, was the founder and chairman of the North Atlantic Salmon Fund. He was a politician for one fish, a man obsessed with saving the Atlantic salmon.

Orri was best known for his pioneering work in "green capitalism," whereby he brokered international fishing rights buyouts with commercial salmon fishermen in the North Atlantic. Through commercial conservation agreements, he helped them transition to sustainable fisheries while protecting the dwindling stocks of North Atlantic salmon.

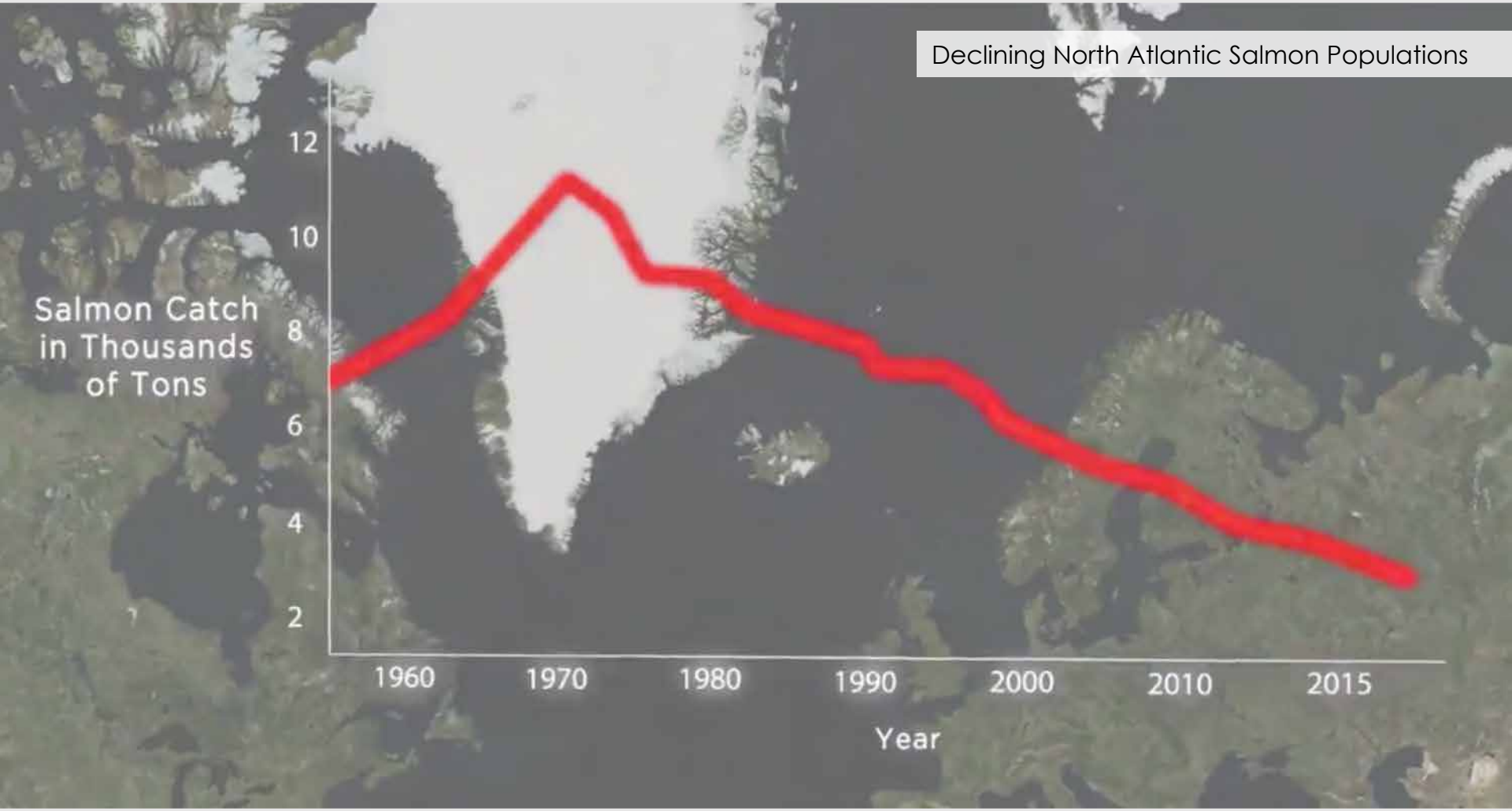
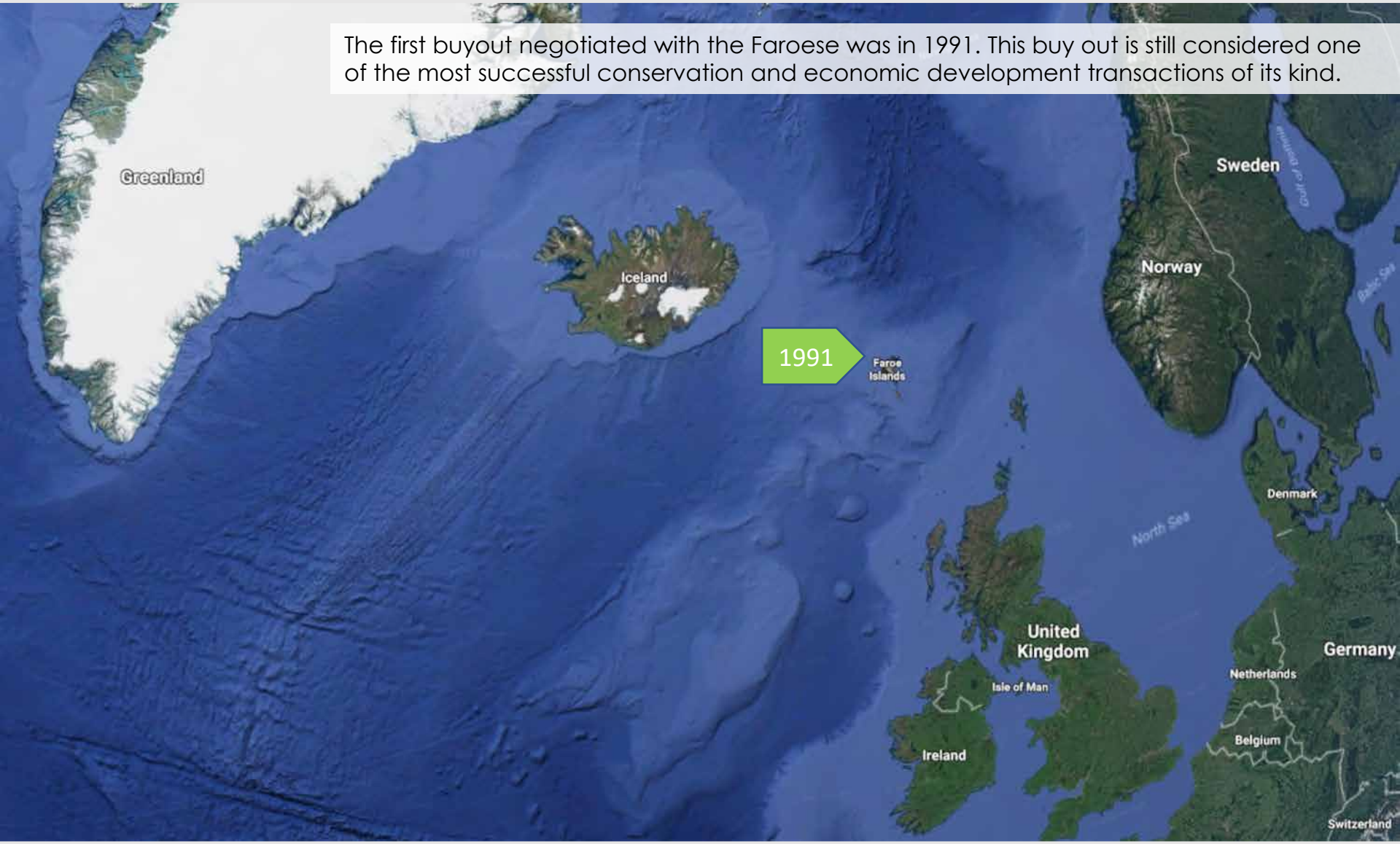



*Image and graphic courtesy of Atlantic Salmon Federation*

The first buyout negotiated with the Faroese was in 1991. This buy out is still considered one of the most successful conservation and economic development transactions of its kind.



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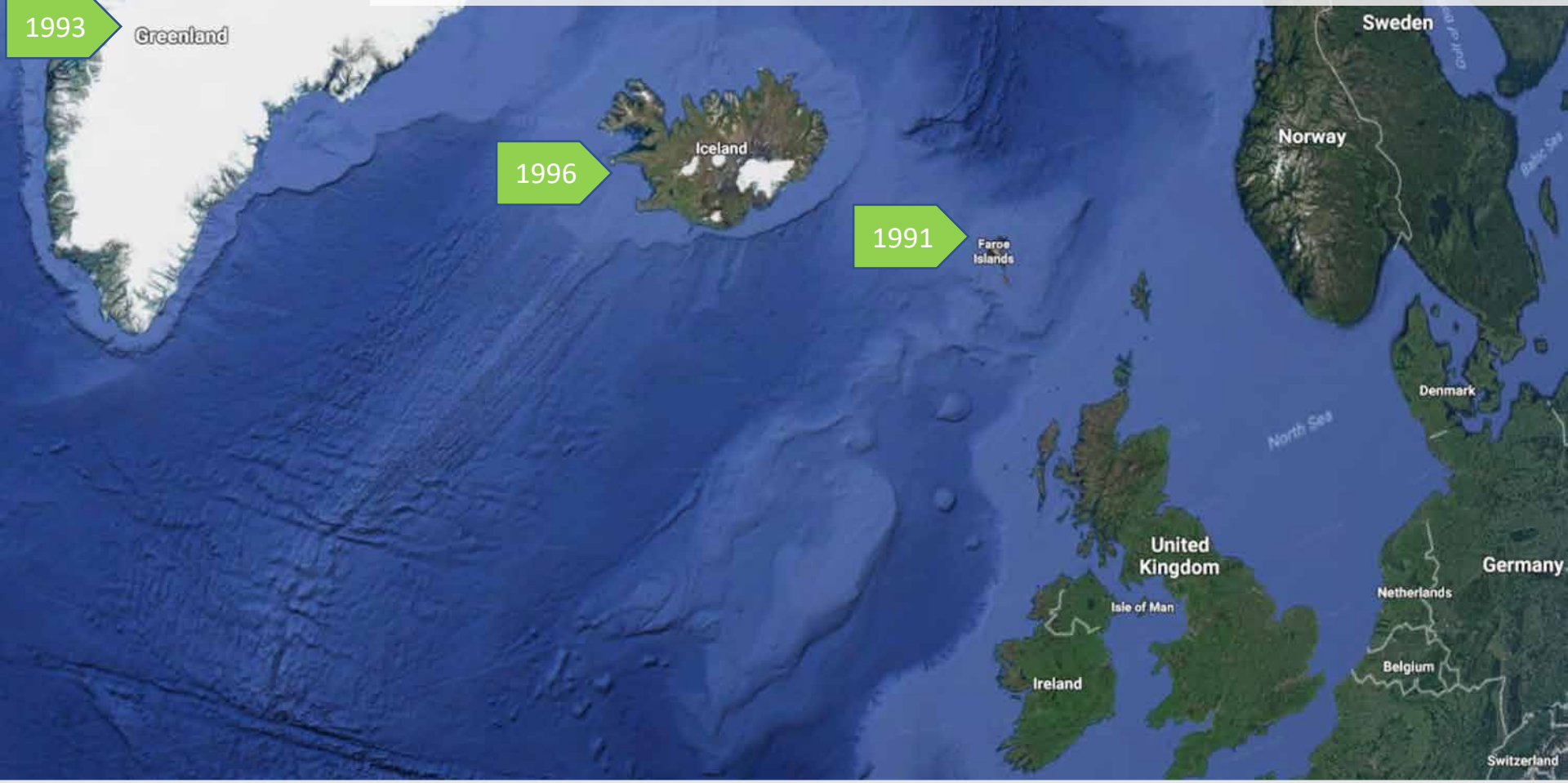

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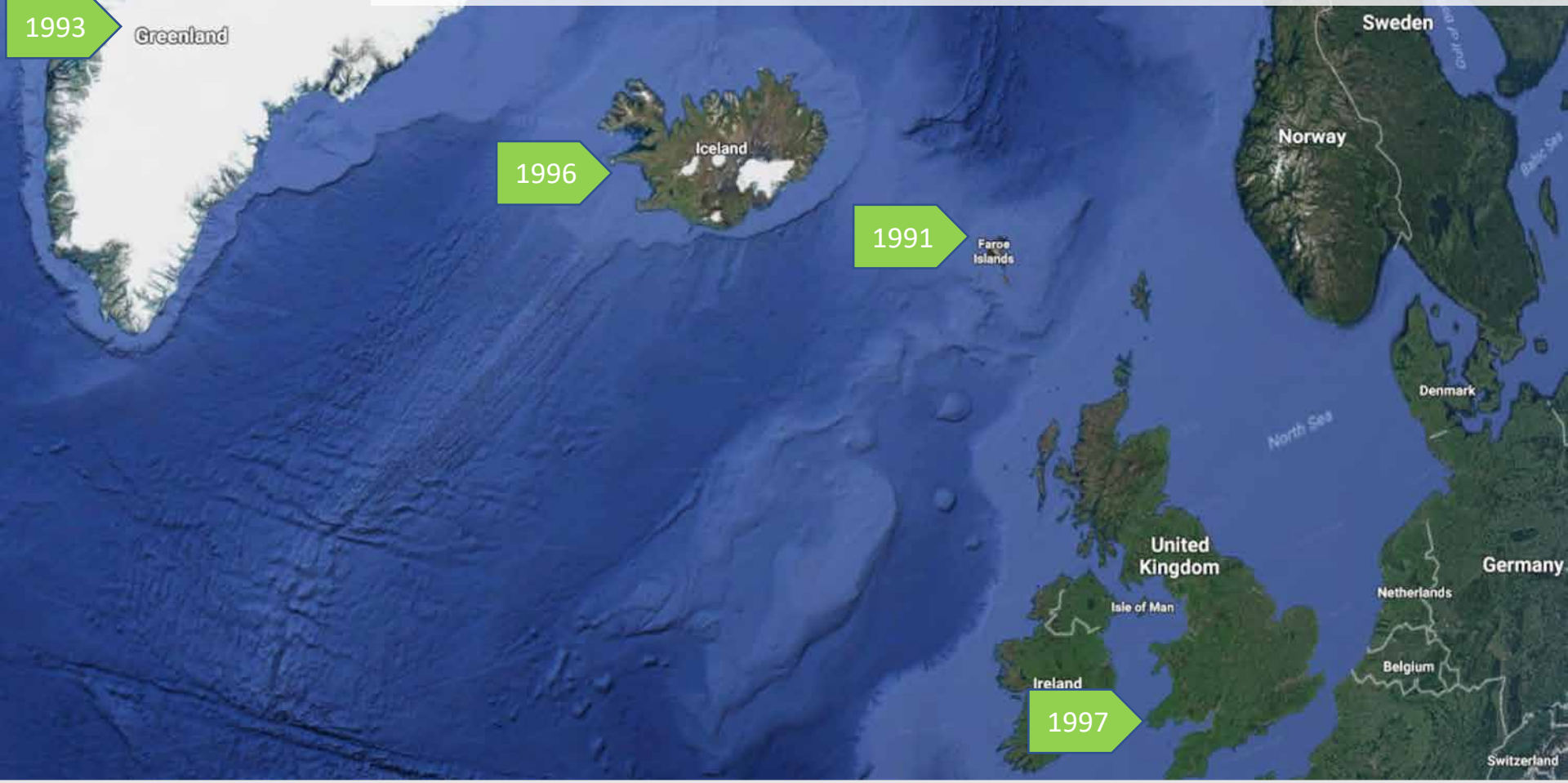

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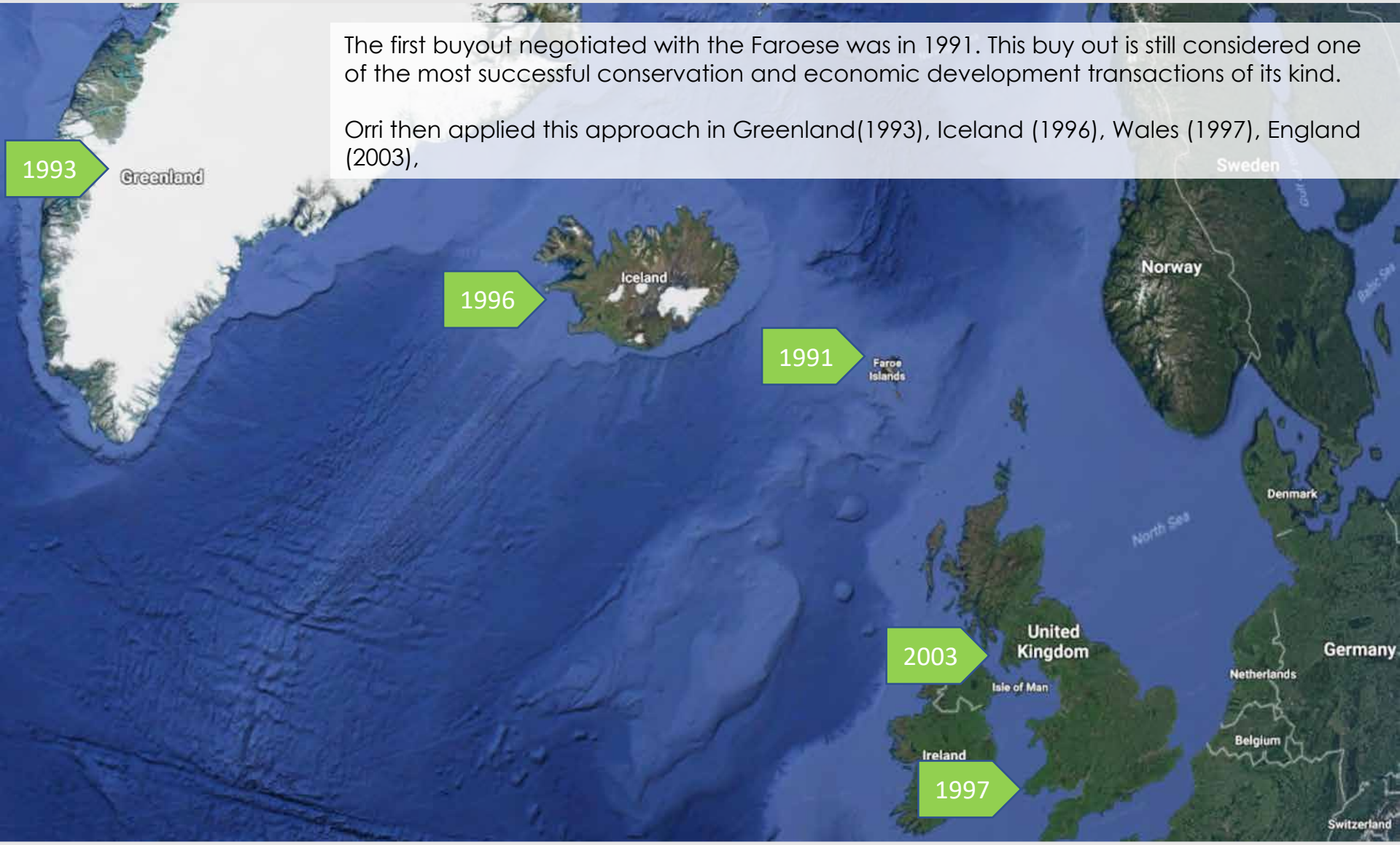

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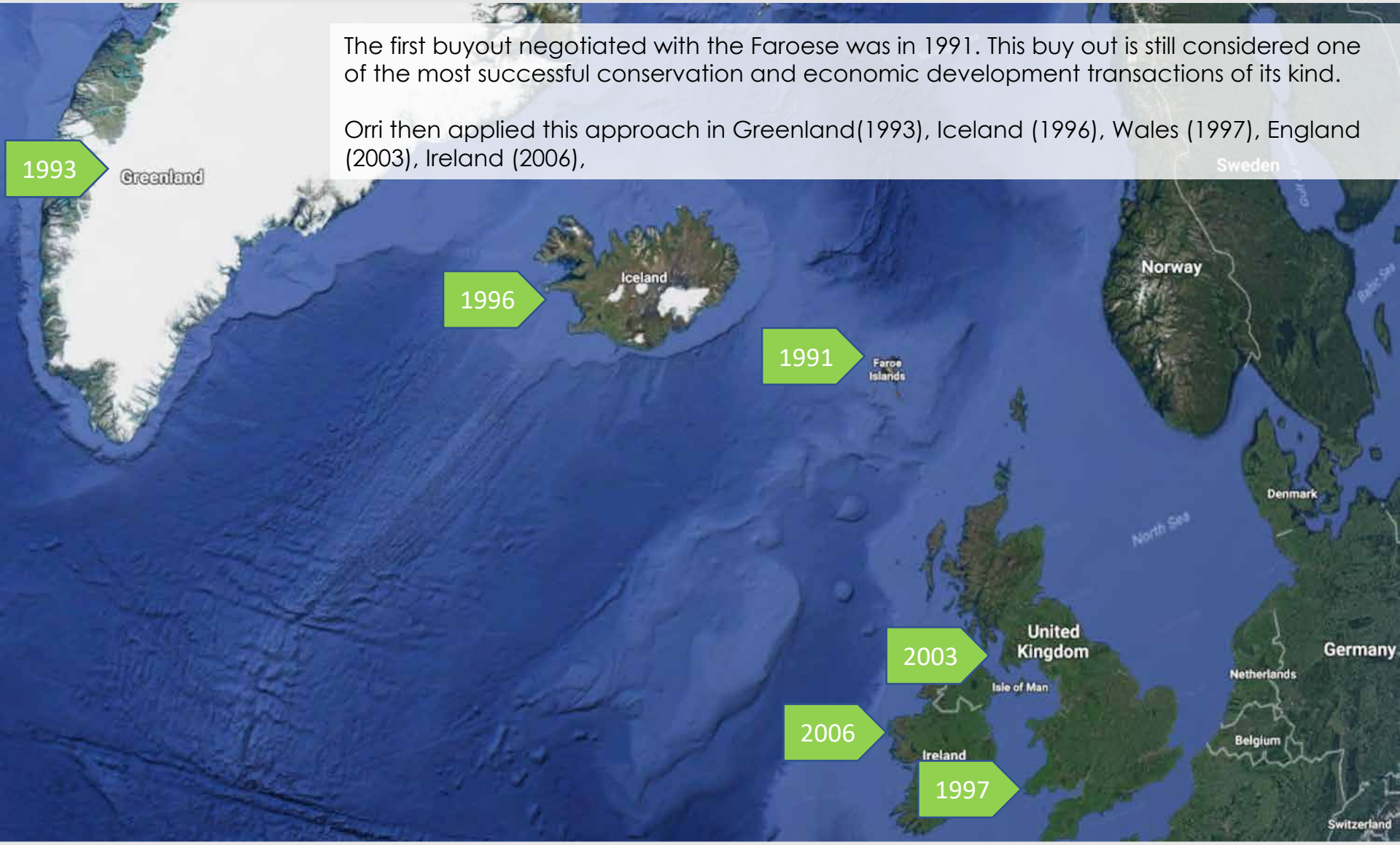

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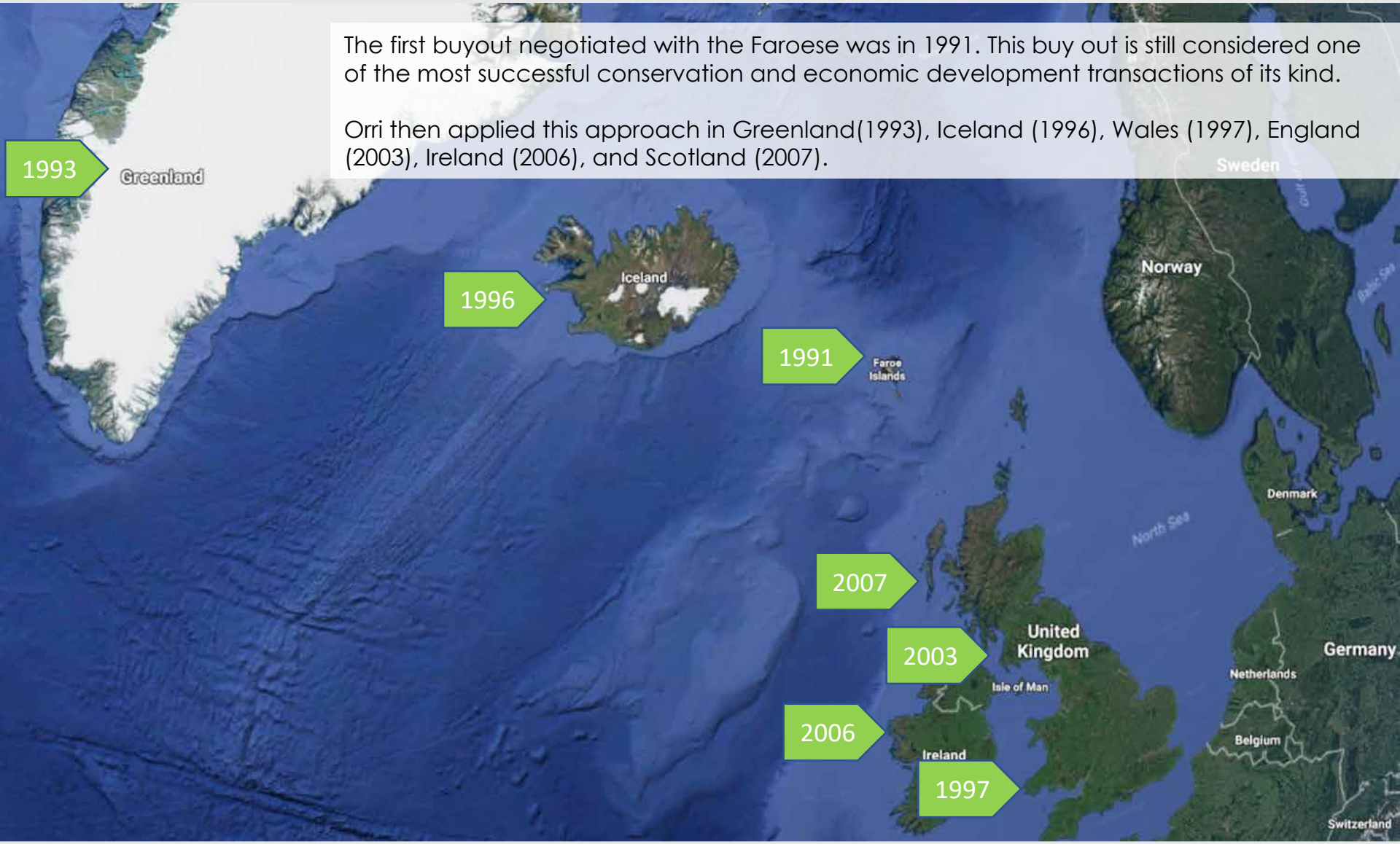
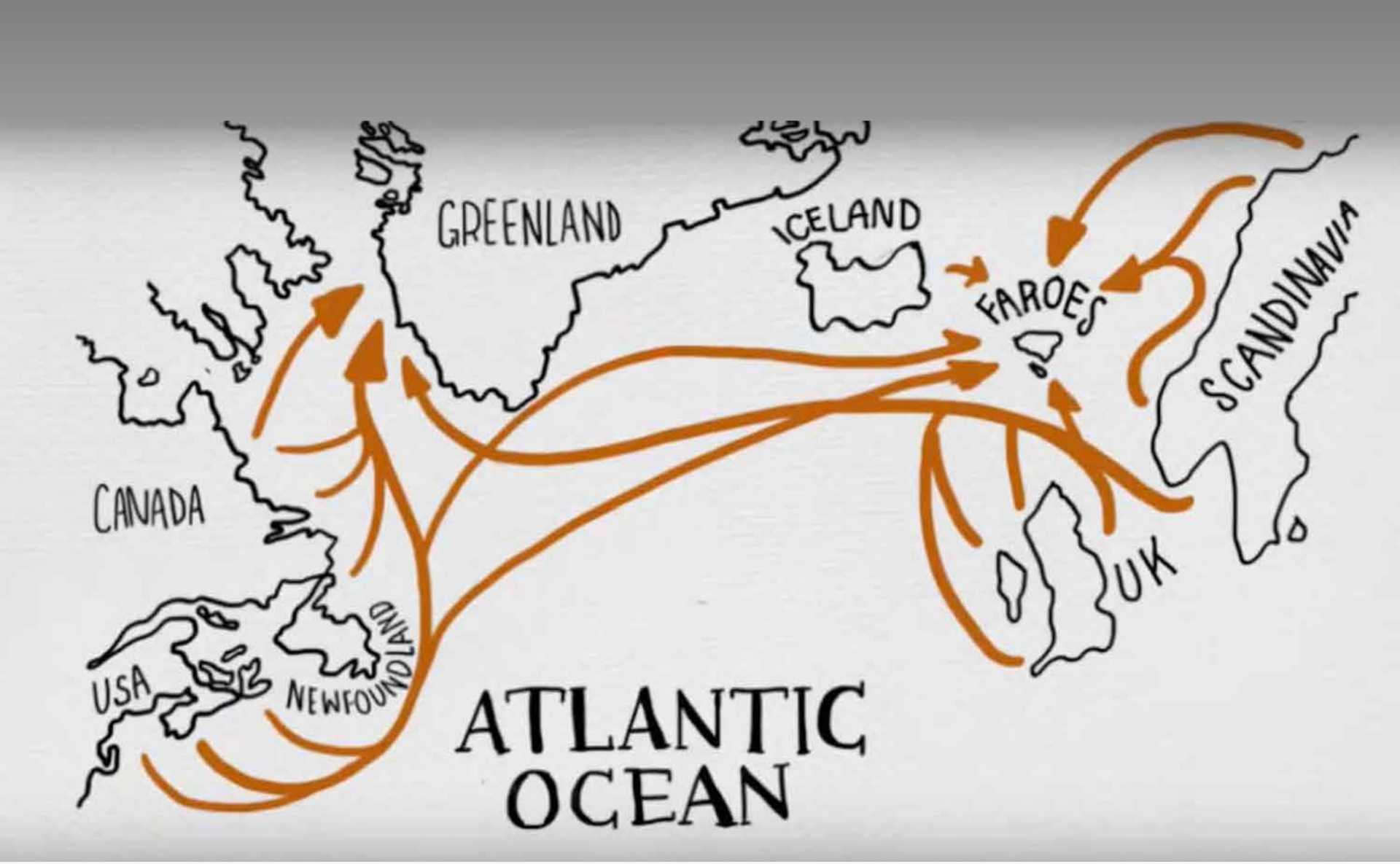
Orri then applied this approach in Greenland(1993), Iceland (1996), Wales (1997), England (2003), Ireland (2006), and Scotland (2007).






Orri believed these agreements are the most important levers to protect the greatest number of salmon, as they directly impact the migratory patterns of fish from over 2,000 rivers in all nations touching the North Atlantic. They address a massive and shared problem across the salmon conservation initiative.

These agreements protect the only true common habitat of the salmon salar.

The tangible results of these agreements have been extraordinary. These commercial conservation agreements have saved in excess of 10 million salmon, and provided hundreds of new jobs in sustainable industries such as ecotourism.


*Image and graphic courtesy of North Atlantic Salmon Fund, International*

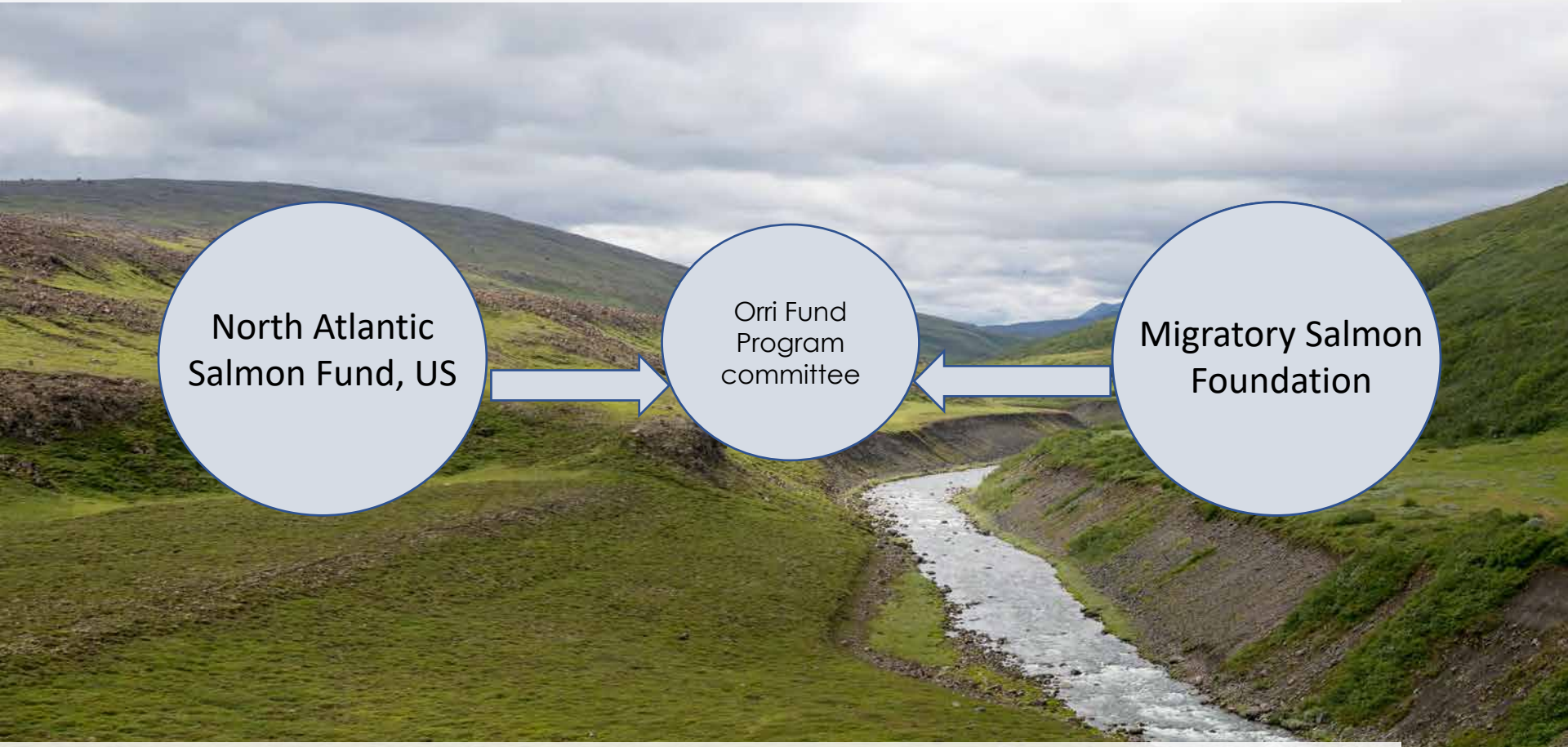
Orri's last wish and his final priority for NASF was to see a permanent endowment created to fund the mixed stock fishery quota agreements in the Faroe Islands and Greenland.

NASF US and the Migratory Salmon Foundation have come together to create this endowment. It is called the ***Orri Fund***.


***The Orri Fund*** was established with the explicit goal of creating an endowment to finance NASF's mixed stock commercial conservation agreements, assuming acceptable terms will continue to be negotiated with all parties.

- While disbursements are overseen by a single Program Committee (see next slide), both NASF US and MSF have independent restricted funds, created and governed according to their individual charters and local country charity laws.
- This allows donors from the US and UK to make contributions in a tax-efficient manner.
- Funds are administered with **zero overhead**, and all donations go directly toward funding commercial net buy outs.
- Target size is undisclosed in order to maintain negotiating leverage with fishermen's unions.

Disbursements from the funds to support buyout agreements are made pursuant to review by the Program Committee.



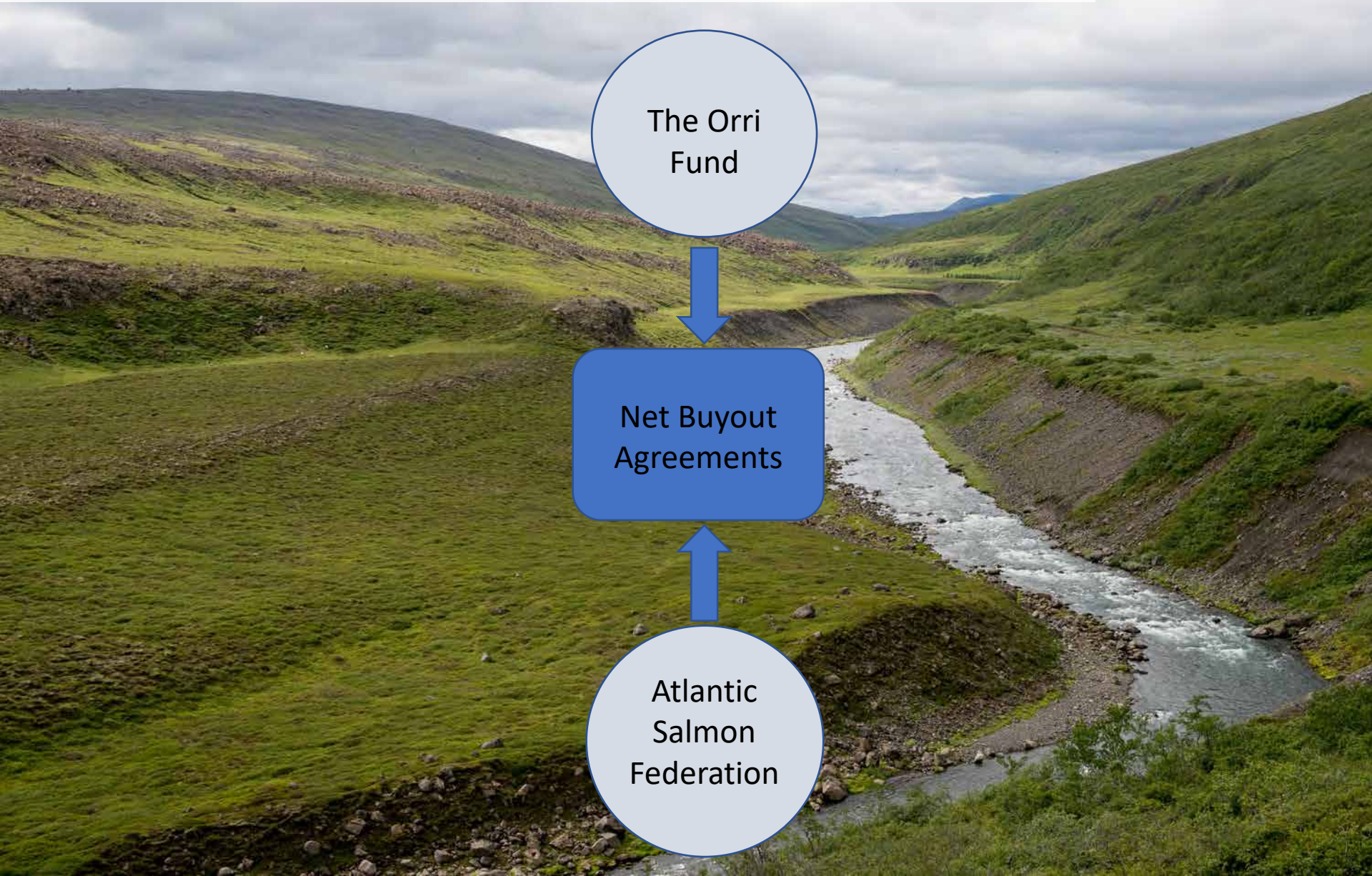

**Program Committee and Governance**

The program committee will work with the negotiating team, supporting their efforts, reviewing draft agreements, and approving payment to support buyouts.

The committee will consist of board members from NASF US, NASF IS, and MSF, as well as high value donors.

**Orri Fund Partner: the Atlantic Salmon Federation**

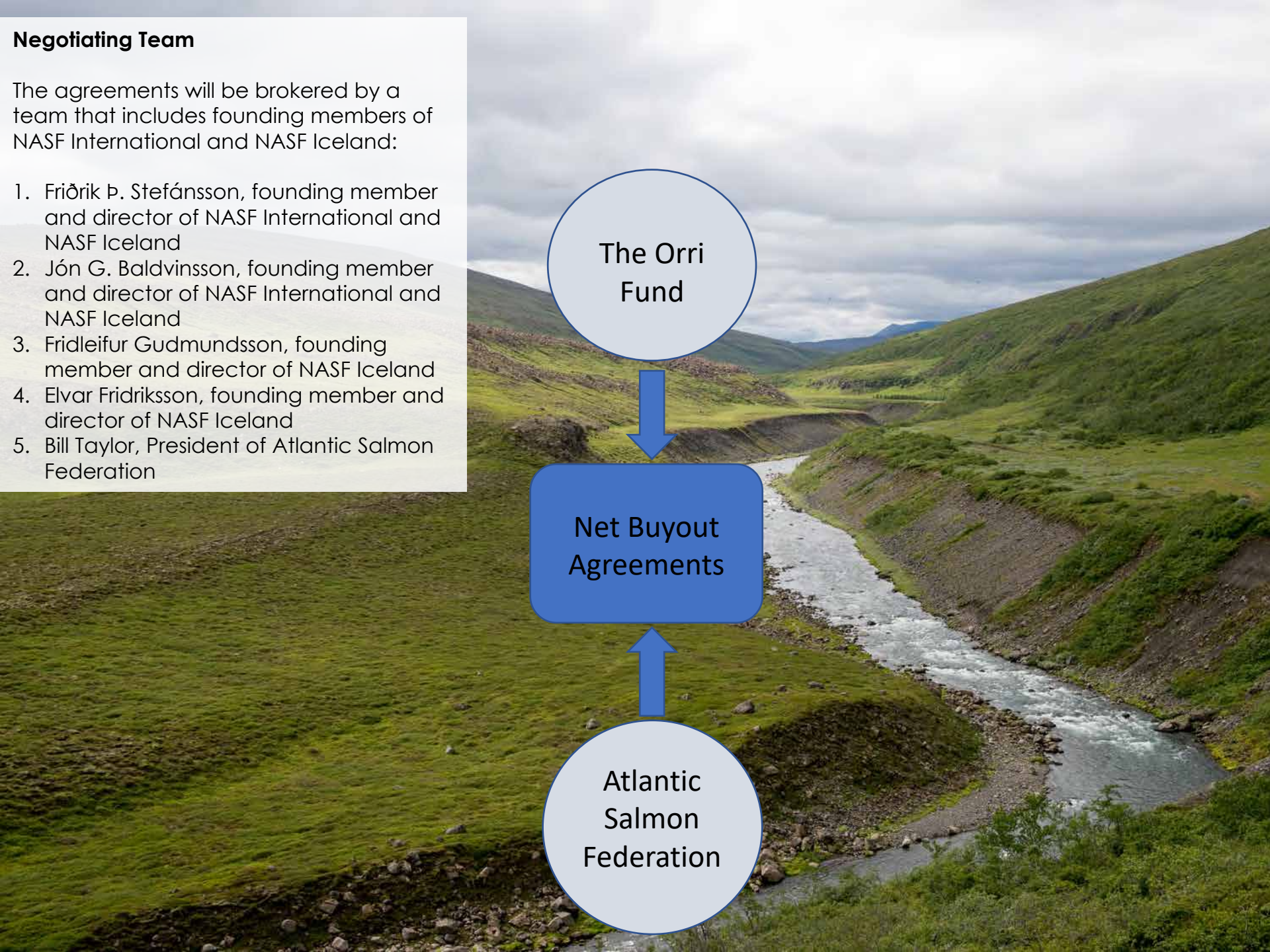
ASF has agreed to partner with the Orri Fund to work together to finance the Faroese and Greenland agreements.



**Negotiating Team**

The agreements will be brokered by a team that includes founding members of NASF International and NASF Iceland:

1. Friðrik Þ. Stefánsson, founding member and director of NASF International and NASF Iceland
2. Jón G. Baldvinsson, founding member and director of NASF International and NASF Iceland
3. Fridleifur Gudmundsson, founding member and director of NASF Iceland
4. Elvar Fridriksson, founding member and director of NASF Iceland
5. Bill Taylor, President of Atlantic Salmon Federation




the ORRI fund
Please visit www.NorthAtlanticSalmonFund.org or contact OrriFund@grassycreekfoundation.org

INRA SCIENCE & IMPACT

Observatoire des Sciences de l'Univers de Rennes
Terre, Écosystèmes et Sociétés

AGENCE FRANÇAISE POUR LA BIODIVERSITÉ
MINISTÈRE DE L'ENVIRONNEMENT

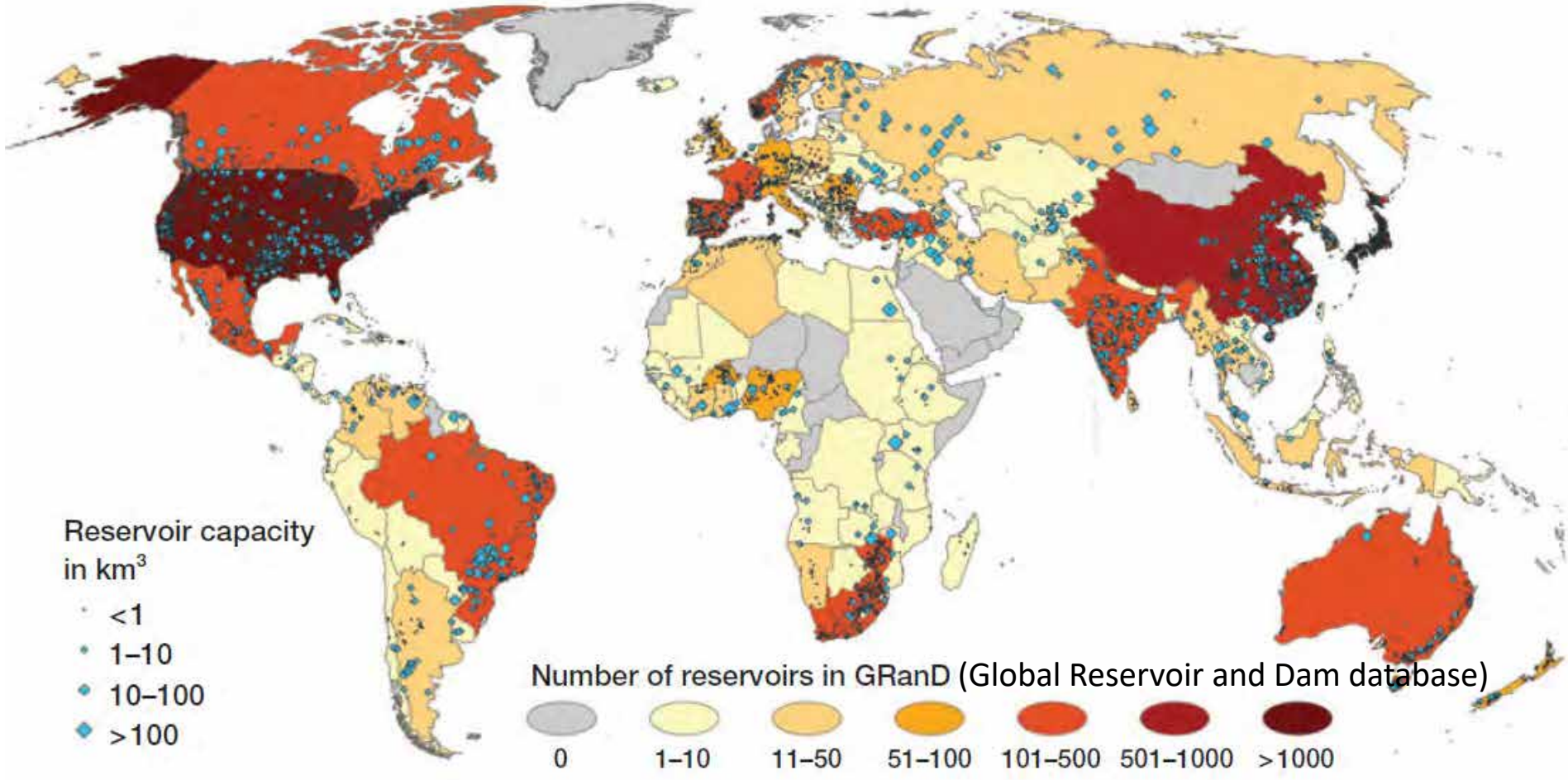
eau seine NORMANDIE
Agence de l'eau

# Monitoring program of the dam removal on the Sélune River (France)

Stéphane Fraisse, Jean-Luc Baglinière & Jean-Marc Roussel

Ecology & Ecosystem health lab
UMR 0985 INRA-Agrocampus Ouest, FRANCE

# Dams: a world-wide distribution




*Lehner et al. 2011*

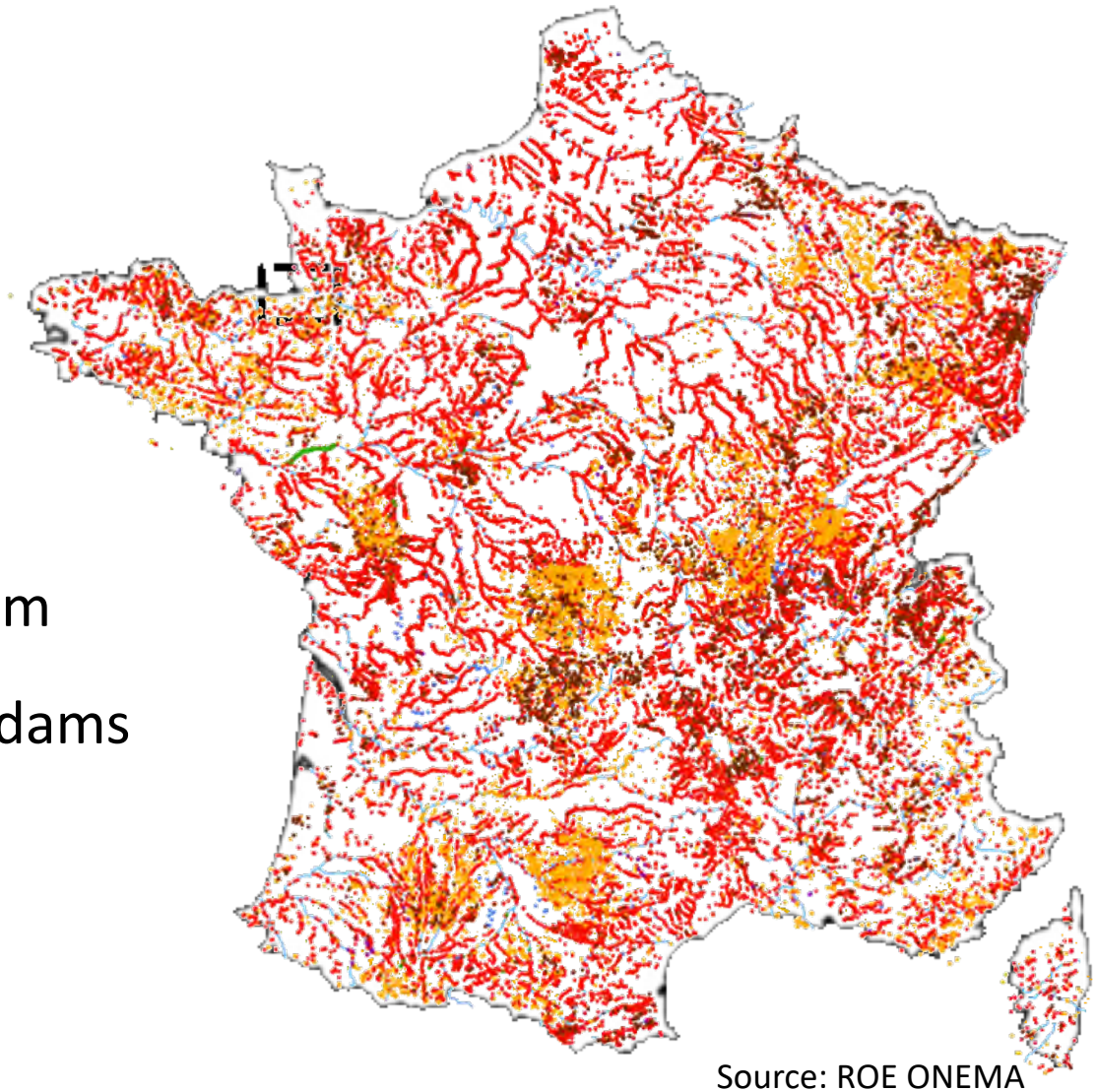
About 37 000 big dams (> 15m) around the world in 2014 (ICOLD 2014)

# Even more small dams and weirs!

USA: 2,5 millions

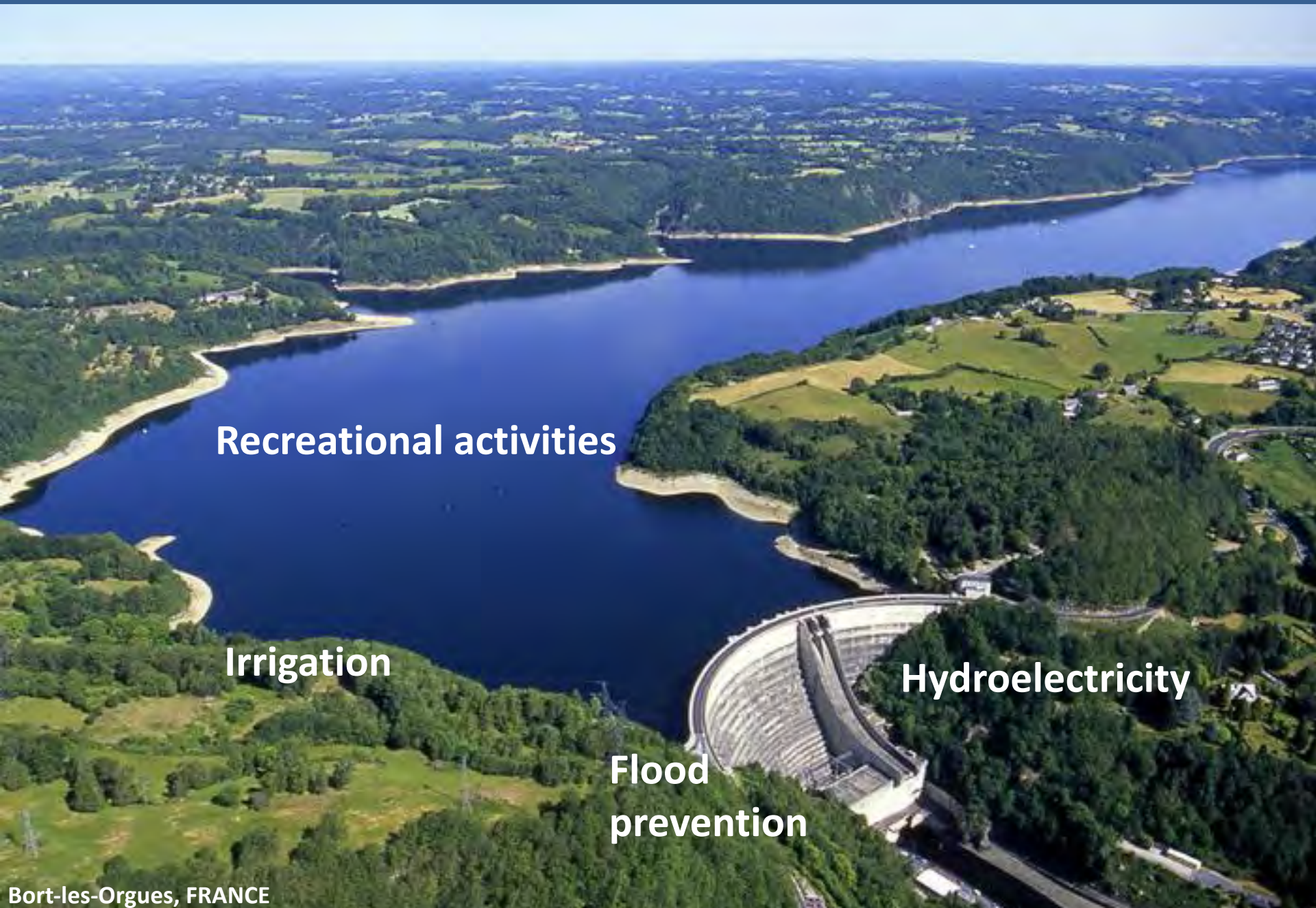
France

- 744 dams > 10m
- 125 000 small dams and weirs

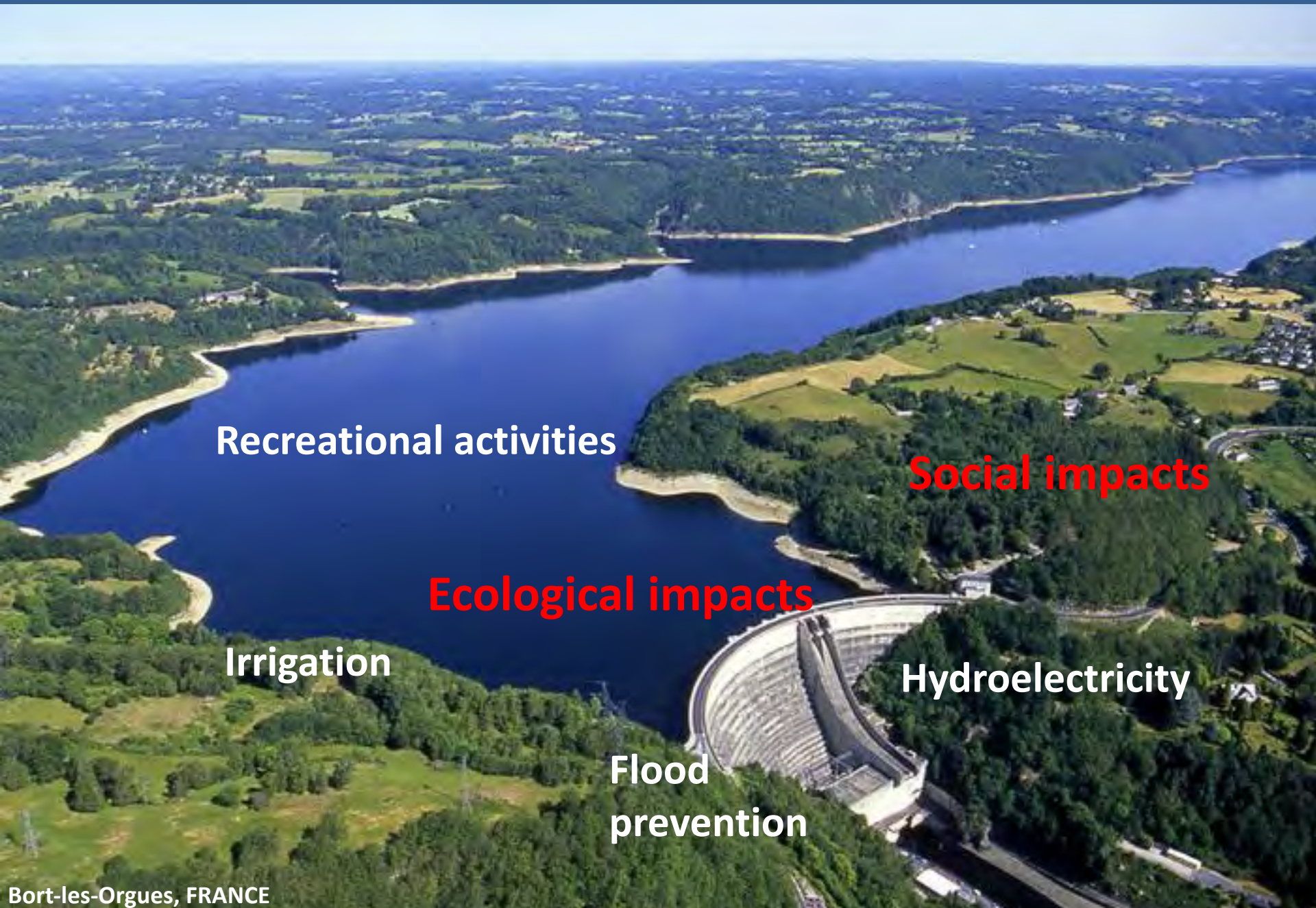


Source: ROE ONEMA

# Dams: solve problems

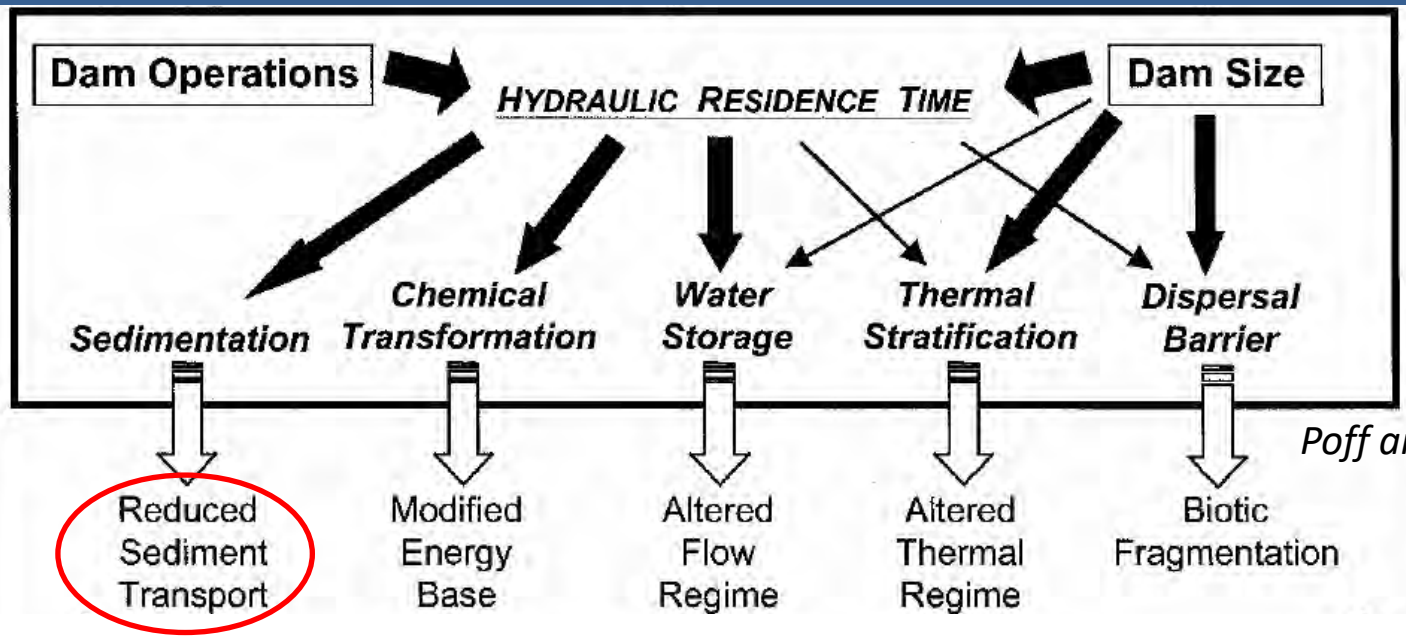


# … But create others

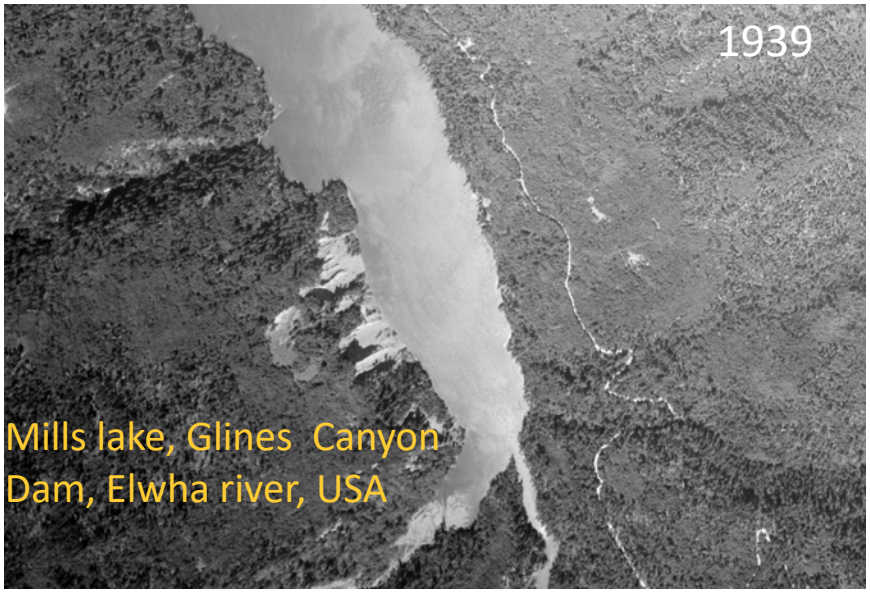



Bort-les-Orgues, FRANCE

# … But create others

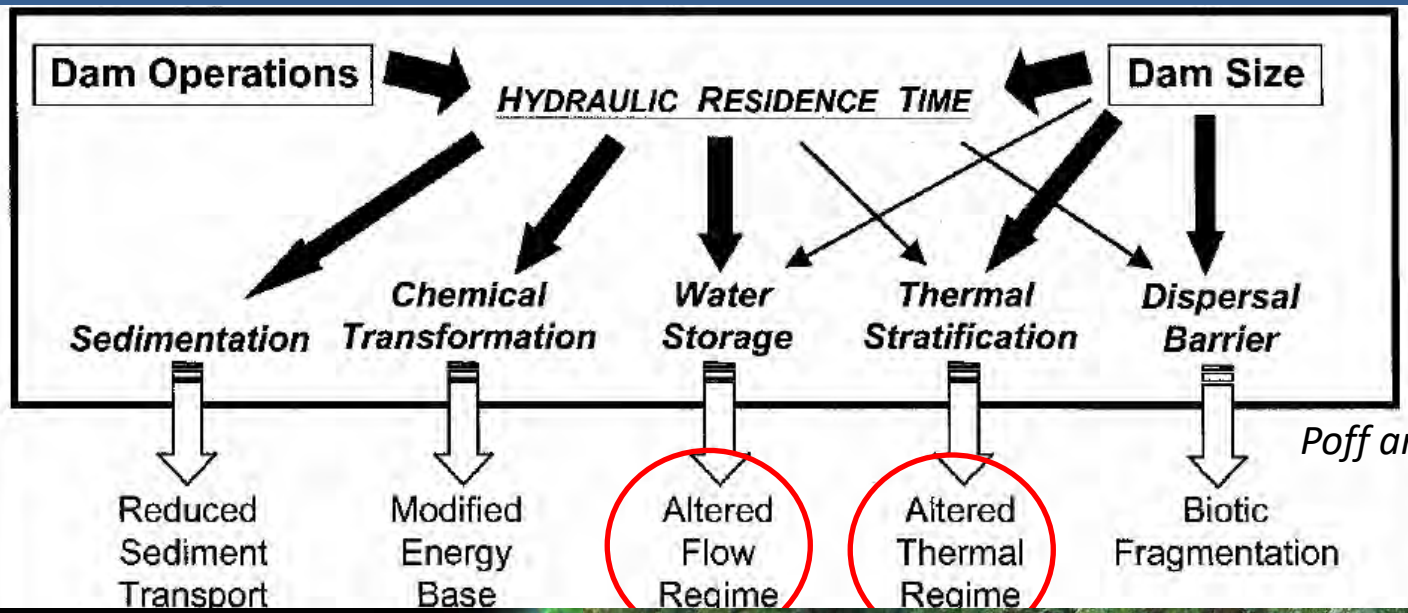



*Poff and Hart 2002*

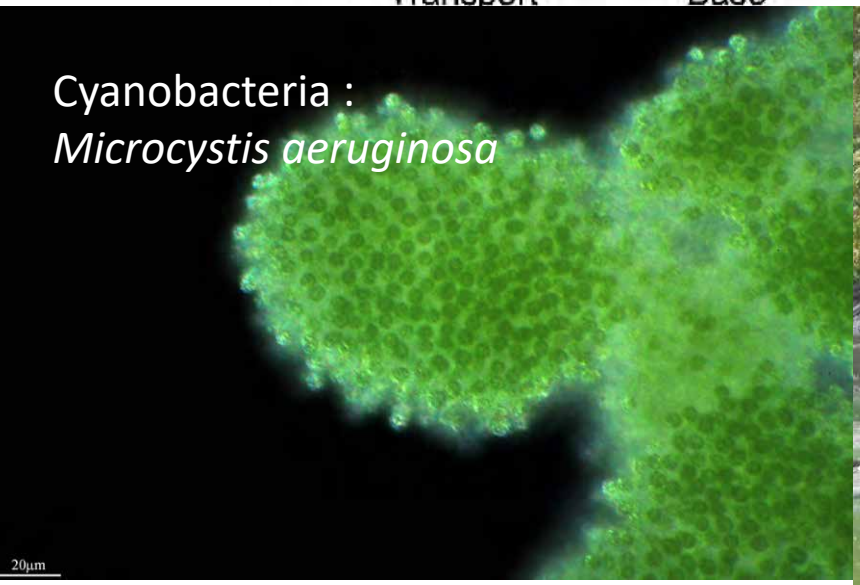



Mills lake, Glines Canyon Dam, Elwha river, USA

# … But create others



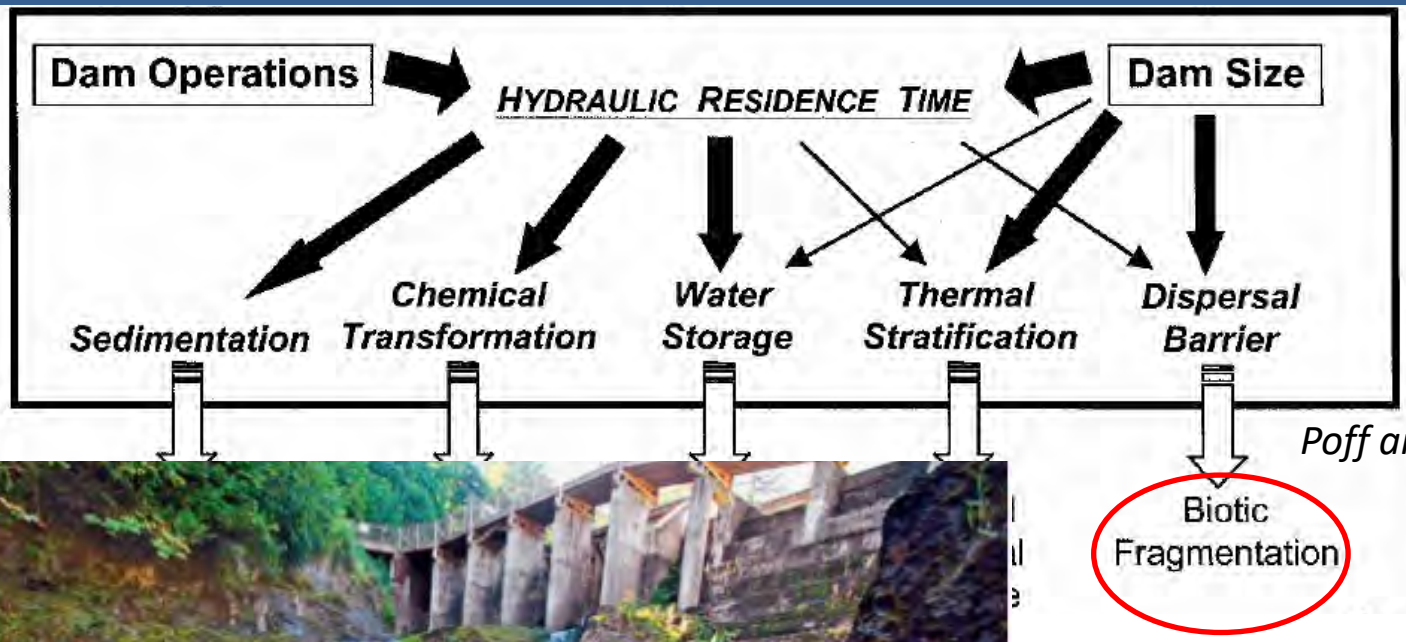

*Poff and Hart 2002*




Cyanobacteria :
*Microcystis aeruginosa*

**Bloom of cyanobacteria, Vezins dam, Sélune River, France**

# … But create others



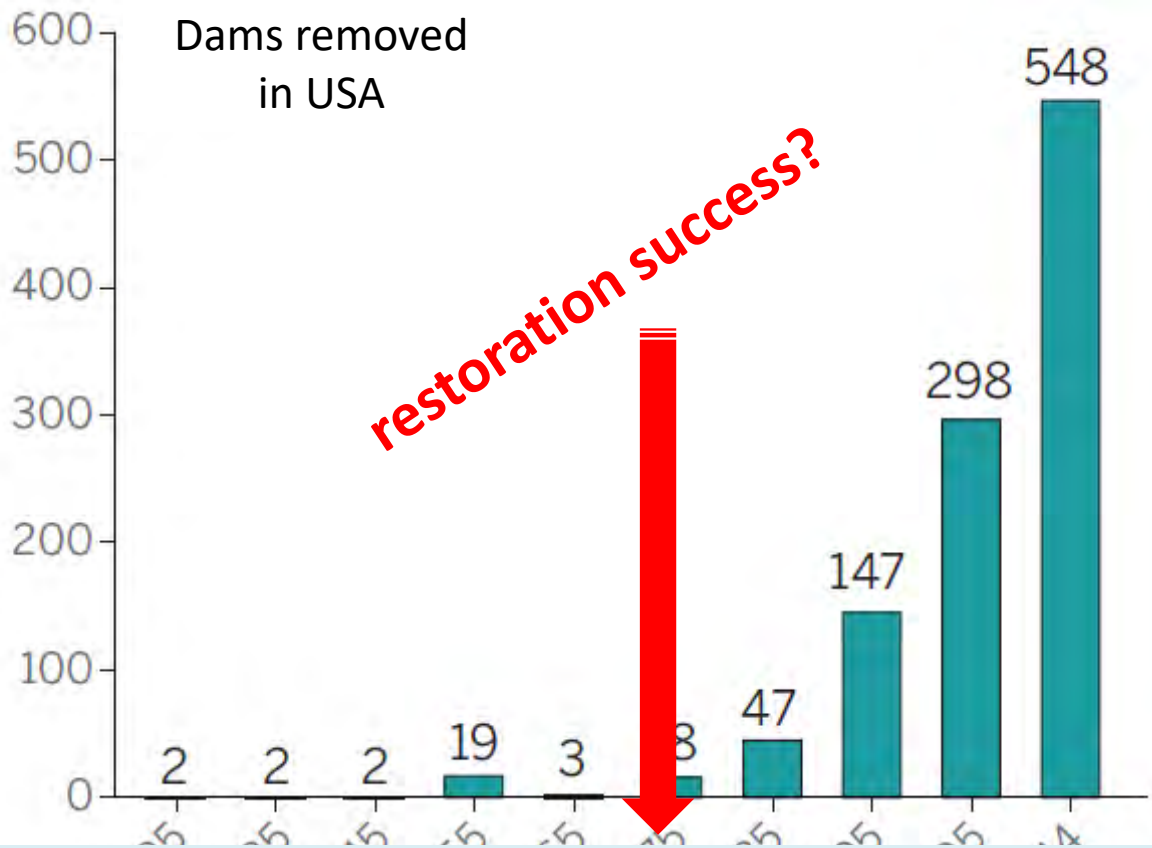

*Poff and Hart 2002*

**USA, west coast 40% salmon habitat loss due to fragmentation**

*Sheer & Steel, 2006*

# Dam removal as a solution for ecological restoration

Ecological issues **X** Aging structures economic and/or safety issues → **Dam removal**



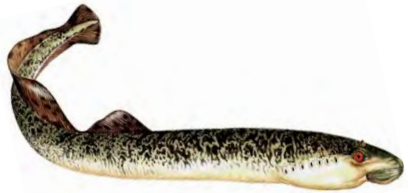

*O'Connor et al. 2015*

**Requires a long-term, multidisciplinary & multiscale approach**

# Dam removal on the Sélune River

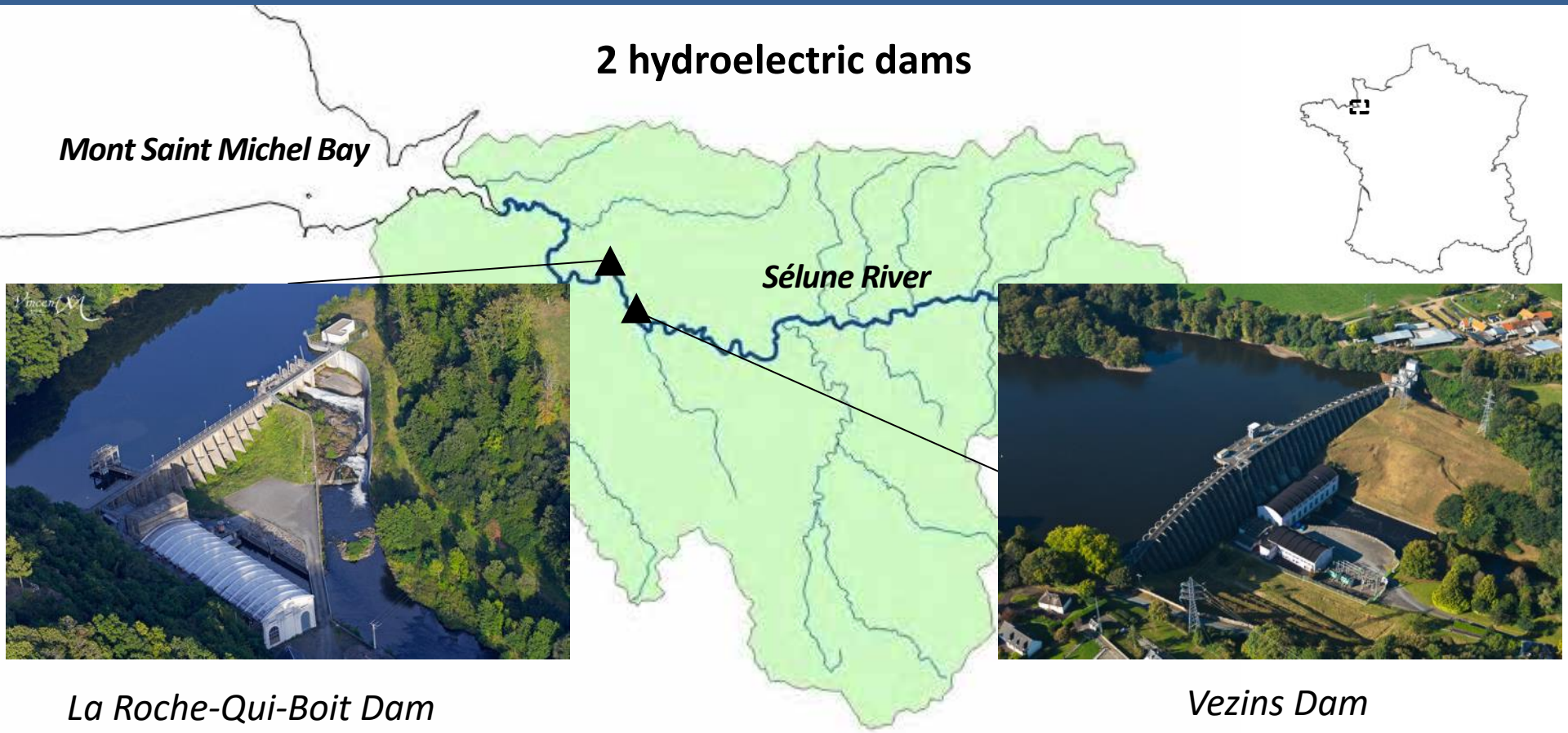

- length: 90 km
- watershed: 1 000 km²
- agricultural landscape
- 57 000 inhabitants

- 7 diadromous species (Atlantic salmon, Sea Trout, European Eel, River and Sea Lamprey, Allis and Twait Shad)

# Dam removal on the Sélune River

## 2 hydroelectric dams




*La Roche-Qui-Boit Dam*

Built in 1916,

height: 16 m, wide: 125m

Impoundment: 0,3 km²

*Vezins Dam*

Built in 1932,

height = 36 m, wide: 278m

Impoundment: 1,5 km²

# Dam removal on the Sélune River

Water quality and ecological issues

**Legislation**

*National & European (Grennelle de l'environnement,Water framework directive)*

Governmental decision in 2009
End of exploitation licence (EDF) (2013)

**dam removal**
with a progressive drawdown
(for 3 years)

**Scientific program**

**Ecology and Ecosystem Health lab**

INRA
SCIENCE & IMPACT

Jean-Luc Baglinière

# The scientific program

**Main goals:**

- ✓ *Restoration success*
- ✓ *Physical, chemical, biological & social processes*

**How?**

- ✓ Long-term studies pre- & post removal
- ✓ Interdisciplinarity (4 research groups & a coordination group)

2012 - 2016

**BEFORE**
**Initial state**

2017 - 2020

**Progressive drawdown (sediment management) & DAM REMOVAL**

2021 - 2027

**AFTER**

# The scientific program

funding agencies

stakeholders

*Coordination group*

*Human Sciences*

1) Social acceptation

2) Land and river uses and perceptions

*Landscape & Riparian vegetation*

1) Landscape/agriculture & biodiversity interactions

2) Recolonization of river banks

*Hydrogeology and Geomophorlogy*

1) fluxes

2) impacts on geomorphology and aquatic habitats

*Aquatic communities*

1) aquatic communities

2) trophic web

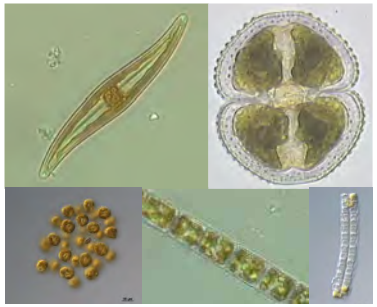
# *Aquatic communities*

**Diadromous & invasive sp** | **Macroinvertebrates & plankton** | **Trophic web**





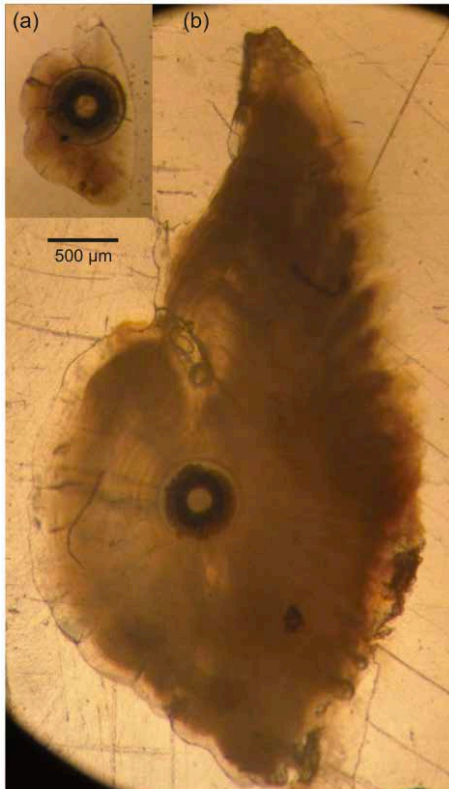




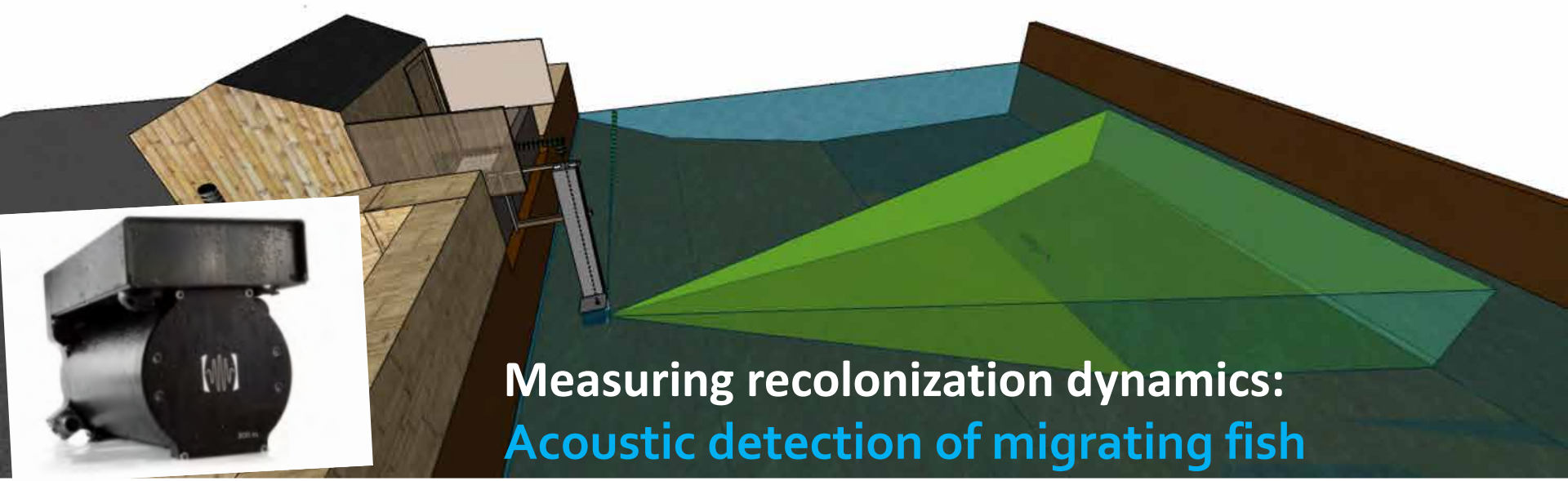
**G. Evanno, J.L. Baglinière, S. Launey, M. Nevoux, J-M Roussel, E. Réveillac, E. Petit, D. Barloy, G. Forget, S. Coudreuse, J.-M. Paillisson, E. Prévost, V. Bolliet, A. Bardonnet, O. Lepais, E. Feunteun, A. Acou, D. Azam, F. Marchand, P. Rault, A. Mouget, F. Martignac, M. Poupelin, L. Pellan, G. Bouger, M. Chorin, C. Gorzerino, C. Piscart, A. Pannard, S. Massé, C. Boulenger**

- Colonisation by diadromous species
- Habitats quantity
- Invasive species spreading
- Interaction between closely related species

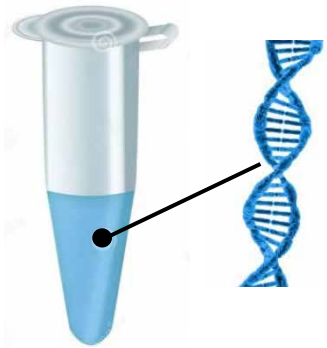
## Otolith microchemistry




## electrofishing

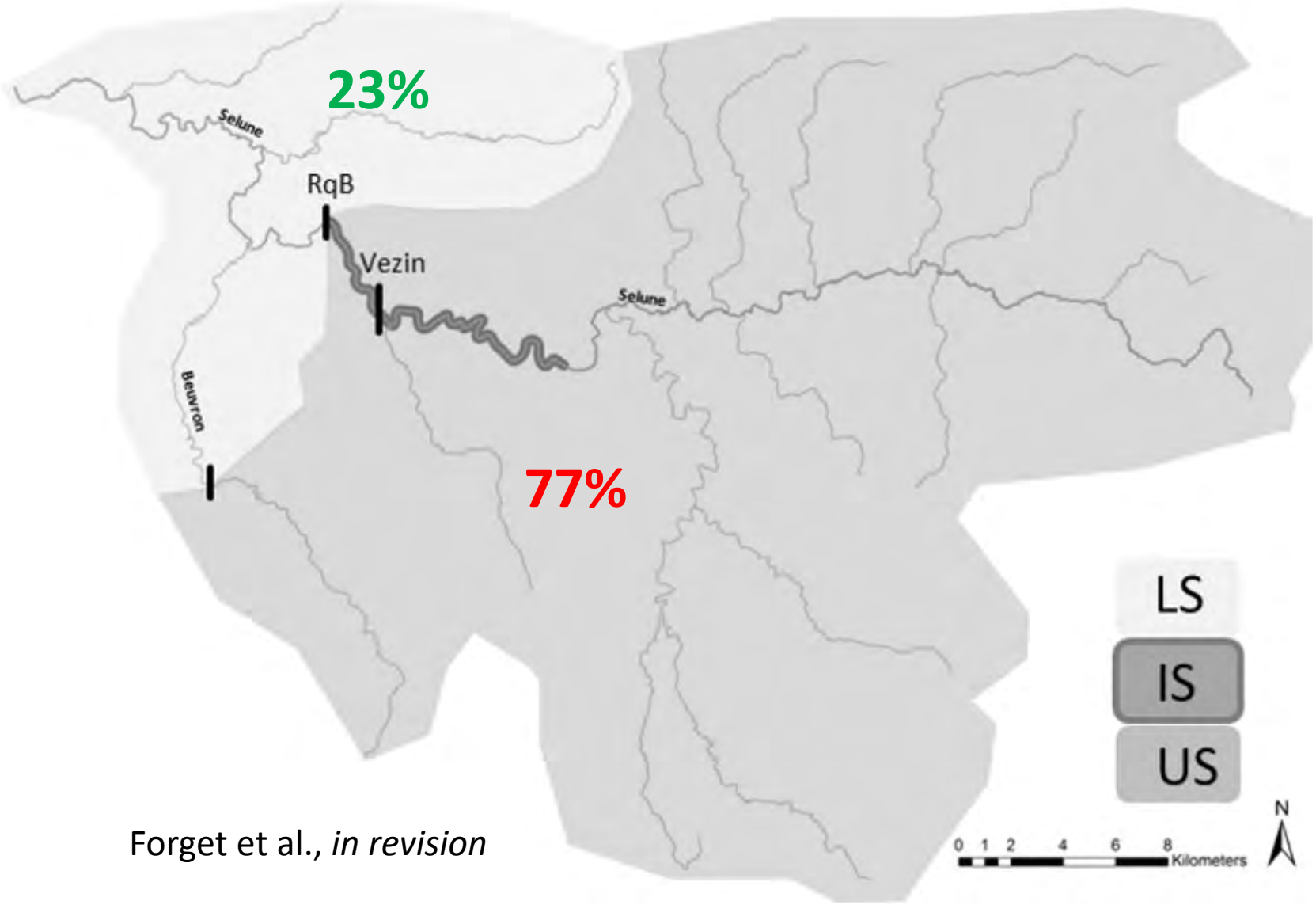


## Measuring recolonization dynamics:
## Acoustic detection of migrating fish



## Distribution of invasive species using environmental DNA

## % of suitable habitat accessible for salmon in the Selune Basin




Forget et al., *in revision*

# Web site

## Selune-river-restoration.inra.fr

Home | News | Map | Scientific studies | Partners | Publications | Contact | Intranet | Français

### Aquatic ecological communities

The project's fourth thematic area is focused on the river's biotic community; the goal is to describe, understand, and model ecosystem restoration in the post-dam period. Research will be carried out at different scales—from the individual scale to the community scale—and will examine biotic and abiotic interactions. In particular, researchers will be looking at organisms of conservation interest that serve as bioindicators: photosynthetic organisms (phytoplankton, biofilm-forming microorganisms, and macrophytes), macroinvertebrates , diadromous fish, and certain mammals. The functional importance of these diffe

**Thank you**

**Biomonitoring**

The project's biomonitoring program will explore how the invertebrate (**Fig. 1**), phytoplankton, biofilm, and macro organisms are often bioindicators for habitat quality.

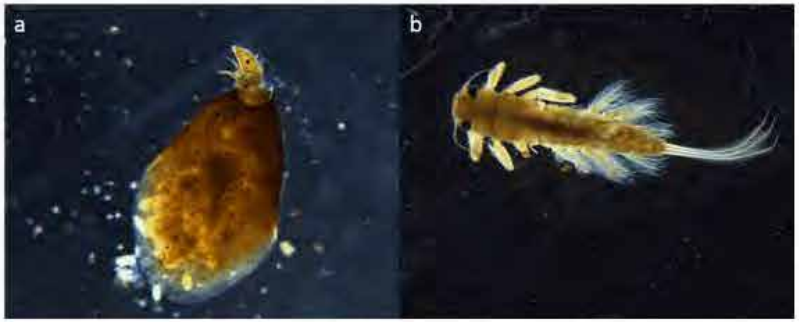



Fig. 1: macroinvertebrates found in the Sélune River (a) *Ithytrichia* sp. (b) *Potamanthus luteus*

However, phytoplankton can also cause problems for humans, when they occur at high levels. For example, certain cyanobacteria produce toxins and can therefore present

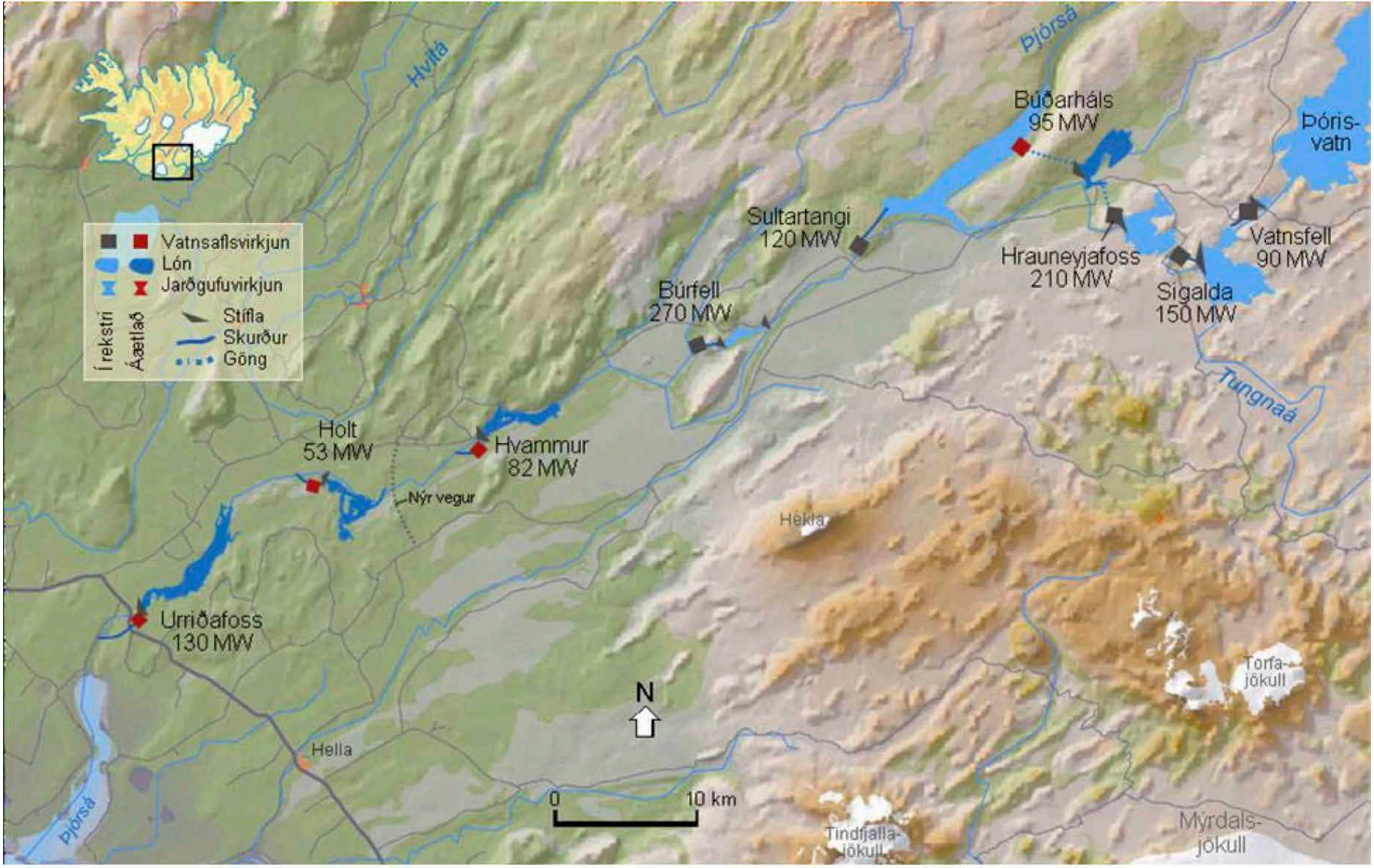
n

logical continuity along the upper stretch of the Sélune like the Atlantic salmon (*Salmo salar*) (**Fig. 2a**), the sea lamprey (*Petromyzon marinus*), the European river lamprey (*Lampetra fluviatilis*) as well as catadromous fish like the European eel (*Anguilla anguilla*). It should also allow the sympatry of fresh water and salt water trout (*Salmo trutta* ecotypes) and different lamprey species (*Lampetra fluviatilis* and *L. planeri*), which will have a significant impact on life-history strategies and population dynamics. Trout and lamprey genetics will be studied, as will the recolonization dynamics of the Atlantic salmon. One concern is that dam removal will allow the spread of invasive species (particularly the signal crayfish, *Pacifastacus leniusculus*) (**Fig. 2b**) that currently occur upstream from the dams. The populations of all these organisms (fish and crayfish) are being characterized using different methods (electrofishing, trapping, environmental DNA sampling, and acoustic cameras). The Sélune's colonization/recolonization by these organisms will be tracked once the dams have been removed.

# The NASF campaign against the Three Dams' Project in river Þjórsá

Gísli Sigurðsson

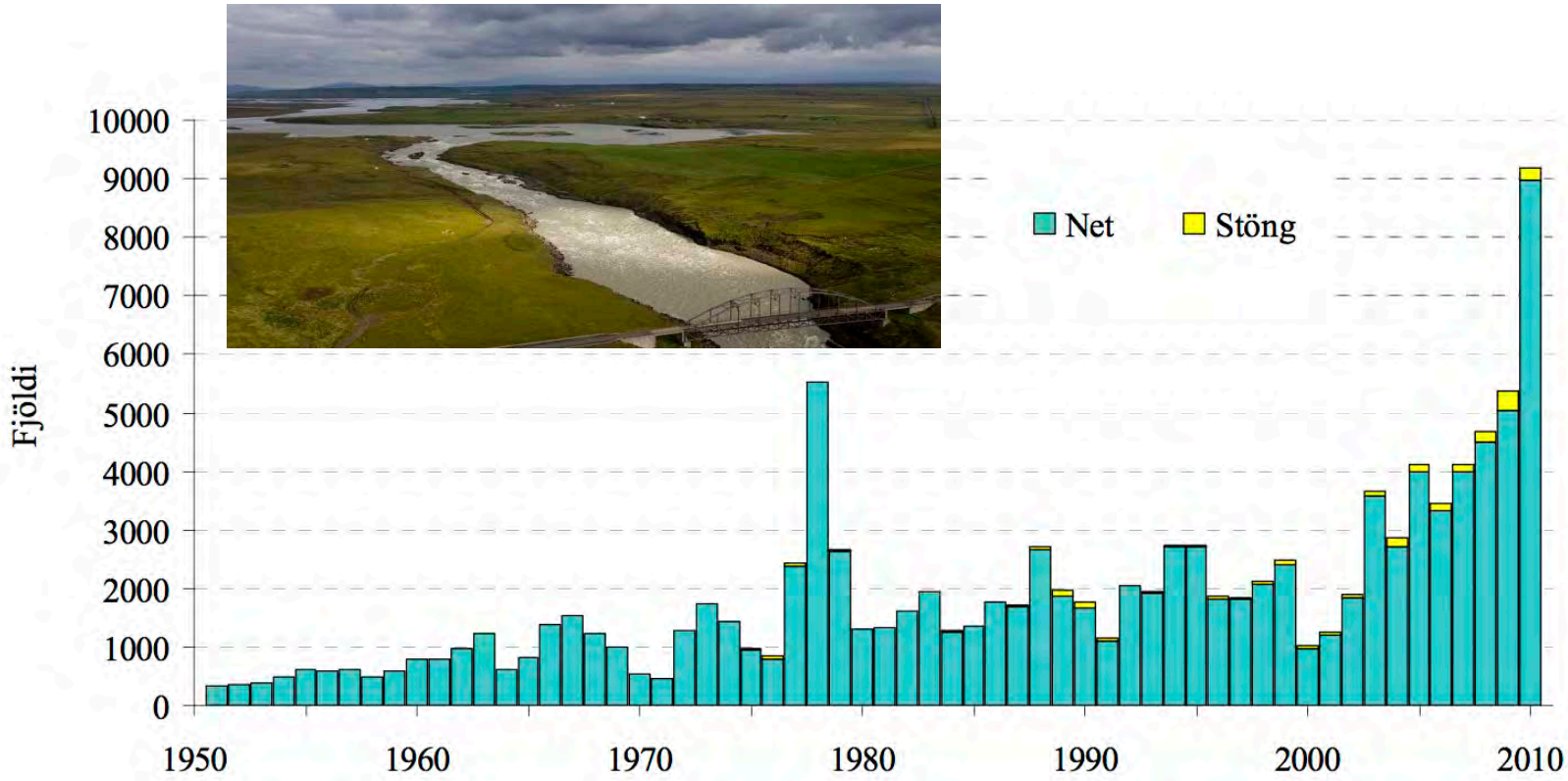
NASF activist, Reykjavík




**1. Mynd.** ***Yfirlitsmynd af virkjunum í neðri hluta Þjórsár***

From The National Power Company's report on the effect of dams on fish in River Þjórsá

# Salmon fishing in Þjórsá and tributaries, both nets and rods 1952-2010




2. **Mynd.** ***Laxveiði í Þjórsá og þverám skipt í neta- og stangveiði frá 1952-2010.***

From The National Power Company's report on the effect of dams on fish in River Þjórsá

# Columbia River Basin

| | |
|---|---|
| Chum Salmon | Columbia River (threatened) |
| Chinook Salmon | Snake River Fall (threatened)<br>Snake River Spring/Summer (threatened)<br>Lower Columbia River (threatened)<br>Upper Columbia River Spring (endangered)<br>Upper Willamette River (threatened) |
| Steelhead | Snake River Basin (threatened)<br>Lower Columbia River (threatened)<br>Middle Columbia River (threatened)<br>Upper Columbia River (endangered)<br>Upper Willamette River (threatened) |
| Sockeye Salmon | Snake River (endangered) |
| Coho | Lower Columbia River (threatened) |
| White Sturgeon | Kootenai River (endangered) |
| Bull Trout | Clark Fork (threatened) |


1 ✱ 8 ✱ 8 ✱ 1

From The National Power Company’s report on the effect of dams on fish in River Þjórsá

FOR THESE REASONS,

THE EFTA SURVEILLANCE AUTHORITY,

pursuant to the first paragraph of Article 31 of the Agreement between the EFTA States on the Establishment of a Surveillance Authority and a Court of Justice, and after having given Iceland the opportunity of submitting its observations,

HEREBY DELIVERS THE FOLLOWING REASONED OPINION

that by not adopting the necessary implementation measures in order to provide for the possibility to challenge the substantive or procedural legality of certain omissions, as stipulated in Article 11(1) of the Directive, Iceland has failed to fulfil its obligation arising from the Act referred to at point 1a of Chapter 1 of Annex XX (*Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment)*, as adapted to the EEA Agreement by Protocol 1 thereto.

Pursuant to the second paragraph of Article 31 of the Agreement between the EFTA States on the Establishment of a Surveillance Authority and a Court of Justice, the EFTA Surveillance Authority requires Iceland to take the measures necessary to comply with this reasoned opinion within *two months* of its receipt.

Done at Brussels, 4 May 2016

For the EFTA Surveillance Authority

Norsk Industri

# ROADMAP FOR SUSTAINABLE GROWTH IN NORWEGIAN AQUACULTURE

*Runar Rugtvedt*

Director
Federation of Norwegian Industries

*Our vision:*

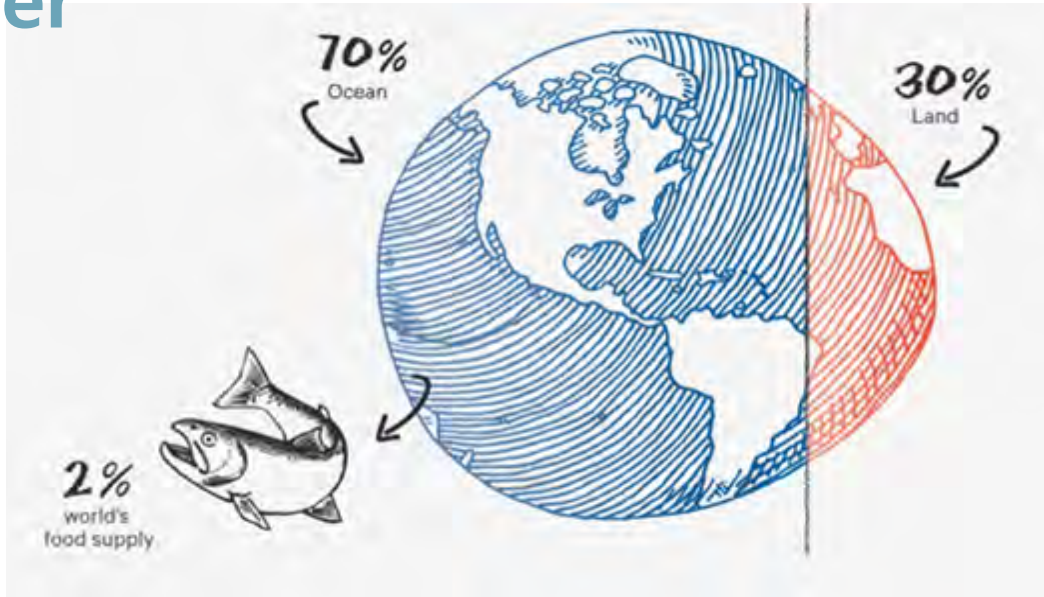
*Farmed Norwegian Salmon shall be the most effecient and eco-friendly production of protein in the world.*

# From 6.6 bn € in 2016 to 20 bn € in 2030

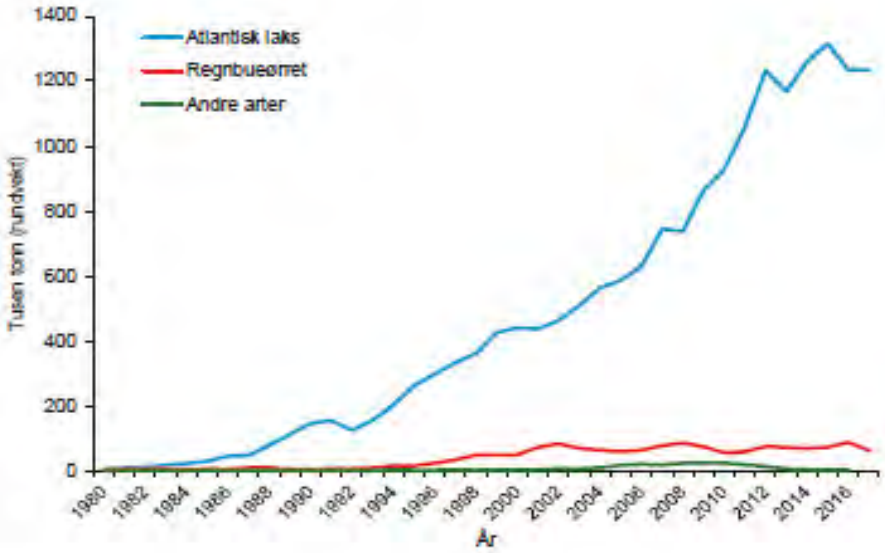
Foto: laks.no

# The Ocean – a key solution provider

- 3 billion more people to feed by 2050
- 70% of the planet is covered by oceans
- 2 % of global food production originates from the oceans



# Production in Norway




**Figur 1.1.**
Mengde produsert atlantisk laks, regnbueørret og andre marine fiskearter i Norge i perioden 1980–2016. Tall for 2017 er foreløpige og basert på mengde laks og regnbueørret rapportert til slakt. Kilde: Fiskeridirektoratet.

***Figure 1.1.***
*Production of Atlantic salmon, rainbow trout and other marine fish species in Norway in the period 1980-2016 (metric tons round weight). Data for 2017 are preliminary and based on tons of salmon and rainbow trout reported for slaughter. Source Directorate of Fisheries.*

# Salmon industry growth restricted by

- Salmon lice

- Escapees

# ....and ocean space

# Increased production requires increased industrialization

- Growth cannot come at the expense of the environment.
- Hence, the demand for an industrial roadmap.

# What does industrialization mean?

# Roadmap for sustainable growth


- Healthy salmon
- Healthy food
- Healthy environment
- Sound production
- Sound economy

# Our zero vision

- No salmon lice
- No escapes from pens
- No resources wasted

*The sector must accept that further growth cannot take place before the challenges of salmon lice on the production are solved and brought under control.*

# Road map

2018
Independent counting teams

2022
Salmon lice **fee**

2027
Salmon lice **free** installations

2050
5x

New technology

2017
7,5 bn. €

2022
Certification

2024
Escape proof installations

2030
20 bn. €

# Existing production methods must change

- 13 % average mortality (2017)
- Strategy for combating salmon lice has not been effective. Treatment cost approx. 0.6 €/kg salmon.
- Increased production costs by 40% between 2012 and 2016.
- No production increase in the same period.

*Source: Kontalianalyse (Not index adjusted)

Picture: Intrafish

# Cleaner fish

- 28 million wild cleaner fish «catched and released» in 2017.
  - Risks: ecological and genetic effects on the wild stocks to poor welfare and spread of “new” diseases
  - Catched in South-East Norway and Sweden, released West and North Norway

- 30 millon cleaner fish produced in 30 farms in 2017 (10 % of the smolt production)

*The sector needs a pro-active approach to emerging challenges, rather than spending resources on solving problems after they have occured.*

# Production regions- The Traffic Light System

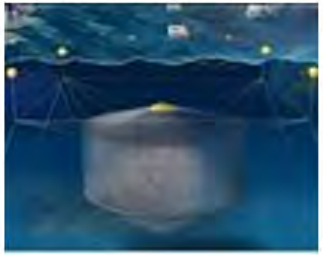

- < 10 % of the wild salmon die because of salmon lice, the production can increase
- 10-30 % of the wild salmon die because of salmon lice
  Production- freeze
  (but increase , exceptions)
- >30 % of the wild salmon die because of salmon lice
  Production reduction
  (exceptions)

Norsk Industri

## Development licenses spur new technological concepts to tackle the industrys' acreage and environmental challenges . Among them ocean farms, sub-sea and closed containment systems

NRS/Aker

Atlantis Subsea Farming

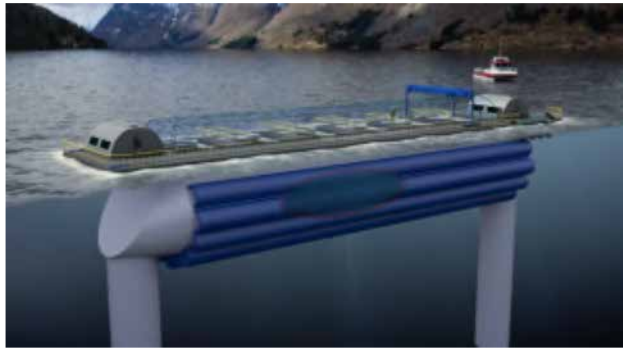


Aqualine

The Egg/Hauge Aqua/Marine Harvest

Havfarm/Nordlaks

Ocean Farm I /Salmar



Pipe Farm/Lerøy

Norsk Industri

# Thank you for your attention!

# Proposed aquaculture regulatory changes in Iceland

Jón Þrándur Stefánsson, Ph.D. Sea Data Center

2018 Salmon Summit

Panel 4: Regulatory update

# The aquaculture debate in Iceland

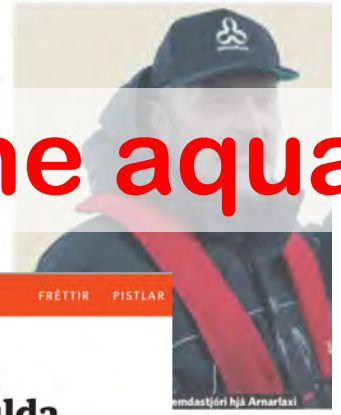
FISKELDISBLAÐIÐ

FRÉTTASKÝRING

Myndir tengjast ekki atburðum sem f

## Aldrei sokkið sjókví hjá Arna

Skemmdir urðu á tveimur sjókvíum Arnarlax hf. nú í febrúar. Allar aðgerðir Arnarlax vegna tjóna á kvíunum miðuðust að því að enginn fiskur slyppi. Þetta segir **Víkingur Gunnarsson**, framkvæmdastjóri hjá Arnarlaxi. Hann segir rangar fréttir af atvikum hafa orðið þess valdandi að umræðan hefur el samræmi við staðreyndir og sannleikur máls vi að vettugi. Aldrei sökk kví eins og sumir fjöln hafa haldið fram í fréttum sínum.



emdastjóri hjá Arnarlaxi

„Við reglulegt eftirlit kom í ljós að einn flothringur umhverfis sjókví í Tálknafirði var brotinn. Kvían sökk og hafði,“ segir Víkingur og áréttar að enn liggi ekki fyrir ástæða skemmda á sjókvinni í Tálknafirði. „Við erum

STUNDIN

FRÉTTIR PISTLAR

FRÉTTIR

## Stórfelldur laxadauði hjá Arnarlaxi vegna sjávarkulda

Eldislax hefur drepist hjá Arnarlaxi vegna sjávarkulda. Umhverfisstofnun staðfe svara frá Arnarlaxi eftir að hafa fengið ábendingu um það. Arnarlax hefur ekki s um málið síðustu þrjá daga. Eftirlitsstarf Arnarlax tekið til skoðunar.

2 FRÉTTIR Innlent

MORGUNBLAÐIÐ LAUGARDAGUR 24. FEBRÚAR 2018

## 53 þúsund laxar drápust

● Svipaður fjöldi laxa drapst hjá Arnarlaxi og veiddist á stöng árið 2016 ● Atvikið megi rekja til öryggisráðstafana ● MAST telur sig hafa fengið skýrar upplýsingar um atvikið og viðbrögð fyrirtækisins

Helgi Bjarnason
Erna Ýr Óladóttir

Líðlega 53 þúsund laxar drápust í sjókví Arnarlax í Tálknafirði eftir skemmdir sem urðu á kvínni í óveðri í byrjun viku. Það er stórauð magn af laxi og stangveiðimenn veiddu í fíllum ám landsins árið 2016.

Óttar Yngvason lögmaður, sem kemur fram fyrir hönd Náttúruverndarsamtaka Íslands, Náttúruverndarfélagsins Laxinn lifi og tíu veiðiréttarhafa, óskaði eftir upplýs-

Morgunblaðið/Helgi Bjarnason

2016 voru veiddir á stöng í öllum íslenska laxveiðiánum 53,600 laxar.

„Hluti laxanna drapst því við áðurnefnt sjókví yfir í óvagga kví. Flothringur kvíarinnar hafði farið í sundur, en inni í honum eru flotbolt og auk þess er annar hringur sem heldur kvínni á floti. Það var því ekki mikil hætta á ferðum, en við viðhöfum hafa valið fyrir neðan okkur og tökum áðurnefnda straum," segir Víkingur Gunnarsson, framkvæmdastjóri Arnarlax. Hann segir af og frá

### Atvikið tilkynnt strax

„Við daglegt eftirlit með sjókvíunum kom í ljós að ein kvían hafði losnaðst í líðvöri. Við tilkynntum atvikið strax til MAST og Fiskistofu og upplýstum um fyrirhugaða ráðstöfun, að færa laxinn. Þar sem ekki var um mengunarslys að ræða lágust okkur að tilkynna atvikið Umhverfisstofnun og höfum beðist velvirðingar á því."

Víkingur segir að flutningur á laxinum hafi heppnast eins og best

tilláinn til slátrunar í vor og sumar. Laxarnir sem drápust verði nú nýttir í ódýrari afurðir eins og t.d. refafóður. Það sé möguleg tjón fyrir Arnarlax, sem hefði getað selt laxinn í slátursstærð fyrir hæsta verð á markaðum í sumar. Enn sé upphæð tjónsins ekki vitað eða hver ber þa

MAST telur sig hafa skýrar upplýsingar um atvikið og viðbrögð fyrirtækisins, að því er fram kemur í svarinu til Óttars, og áltur út frá þeim gögnum og ljósmyndum sem hún hefur fengið frá Arnarlaxi að

## Loðnuvinnslan mótmælir áformum um fiskeldi

200 mílur mbl 5.12.2017 9:32

Löndun hjá Loðnuvinnslunni á Fáskrúðsfirði. *mbl.is/Albert K*

Stjórn Loðnuvinnslunnar hf. á Fáskrúðsfirði mótmælir harðleg um stórfellt laxeldi í Fáskrúðsfirði. Segir í tilkynningu frá stjór innar að áformin séu nú í umsagnarferli án þess að fram hafi f armat á áhrifum þess á lífríki og burðarþol fjarðarins.

„Samkvæmt fyrirliggjandi frummatsáætlun eru áform um 15.0

## Mesta aukningin í fiskeldi

Smári Karlsson 13/02/2018

*Fiskeldi er sú atvinnugrein sem er í mestri sókn á Vestfjörðum.*

Heildaratvinnutekjur á Vestfjörðum hækkuðu um tæp 5 prósent á tímabilinu 2008 til 2016. Eftir lækkun í framhaldi af hruninu 2008 hækkuðu atvinnutekjur um 7 prósent bæði árin 2015 og 2016. Á landsvísu hækkuðu atvinnutekjur um 9,7 prósent. Þetta kemur fram í nýrri skýrslu sem Byggðarstofnun gaf út í dag.

Á Vestfjörðum voru mestar atvinnutekjur voru greiddar í fiskveiðum en nokkuð þar eftir koma fiskvinnsla, opinber stjórnsýsla, fræðslustarfsemi og heilbrigðis- og félagsþjónusta.

Mesta aukningin á atvinnutekjum á Vestfjörðum varð í fiskeldi en nokkuð lang[illegible] á [illegible] fræ[illegible]sta[illegible]semi, heilbrigðis- og félagsþjónusta og gisting- og veitingar. Veruleg samdráttur varð hins vegar í mannvirkjagerð og opinberri stjórnsýslu auk fjármála- og vátryggingastarfsemi. Meðalatvinnutekjur í Ísafjarðarbæ eru á pari við landsmeðaltal en aðrir hlutar Vestfjarða rétt undir því.

FRIÐJUDAGUR 13. MARS 2018 FRÉTTABLAÐIÐ 11

## „Fiskeldi verði sterk og öflug atvinnugrein“



Einar K. Guðfinnsson formaður Landssambands fiskeldisstöðva

Jón Þór Ólason, formaður Stangveiðifélags Reykjavíkur og lögmaður, skrifar grein í Fréttablaðið 6. mars og svarar grein sem ég hafði ritað í sama blað. Greinarhöfundur hafnar því að unnt sé að stunda laxeldi í sjó í sátt við náttúruna. Þetta er skýr og áfdráttarlaus skoðun og virðist leik í sér bann við atvinnurekstri sem þegar er hafinn, þar sem fjárfest hefur verið fyrir tugi milljarða, hundruð starfa orðið til og er orðinn burðarás í atvinnulífi byggðarlaga á landsbyggðinni, svo fátt eitt sé nefnt.

Meginforsenda greinarhöfundar er röng og því fellur málflutningur hans um sjálfan sig.

### Fiskeldi umfangsmeira en veiðar á villtum fiski

Hér á landi starfar fiskeldi samkvæmt mjög strangum reglum sem byggjast á lagafyrirmælum og reglugerðum sem ætlað er að tryggja að hér megi byggja upp fiskeldi í góðri sátt við náttúruna. Fiskeldi er stundað um allan heim og er snar þáttur í fæðuframboði sem fer vaxandi með ári hverju. Þannig stefna stjórnvöld hvarvetna að því að auka fiskeldi sitt, jafnframt því

að setja strangar reglur um starfsemina. Nú er svo komið að í gegn um fiskeldi í heiminum verður til meiri fiskframleiðsla en sem nemur veiðum og vinnslu á villtum fiski. Á síðasta ári nam laxeldi eitt og sér um 2,5 milljónum tonna í heiminum.

### Fiskeldi á grundvelli varúðarsjónarmiða

Hér á landi höfum við byggt upp fiskeldi á grunni mikilla varúðarsjónarmiða. Árið 2004 var sett reglugerð sem bannaði í raun sjókvíaeldi á laxi í nágrenni við helstu laxveiðiár okkar. Þetta fyrirkomulag hefur sannað gildi sitt.

Til viðbótar við þetta hafa verið innleiddar strangar kröfur um búnað, sem sannað hafa gildi sitt í Noregi, þar sem búnaðurinn hefur verið í notkun um árabil. Sést það meðal annars á því að slysasleppingar á laxi eru nú brotabrot af því sem áður var.

Hér á landi er gert burðarþolsmat á fjörðum og hafsvæðum, sem felur í sér „mat á þoli fjarða eða afmarkaðra hafsvæða til að taka á móti auknu lífrænu álagi án þess að það hafi óæskileg áhrif á lífríki og þannig að viðkomandi vatnshlot uppfylli umhverfismarkmið", eins og segir í lögum um fiskeldi.

### Lítil áhrif á náttúrulega stofna

Í fyrrasumar gerði Hafrannsóknastofnun áhættumat vegna möguleg[illegible] erfðabl[illegible]ndunar á milli eldislaxa og náttúrulegra laxastofna. Meginniðurstaða þess mats var að „líkindi gerir almennt ráð

**Það er ljóst að fiskeldi hér á landi er komið til að vera. Um fjögur þúsund ibúar munu hafa afkomu af fiskeldi og afleiddum störfum þegar það verður komið upp í þau 71 þúsund tonn sem áhættumat Hafrannsóknastofnunar gerir ráð fyrir.**

fyrir litlum áhrifum á náttúrulega stofna fyrir utan nokkrar ár". Og í skýrslu stofnunarinnar er einnig vakin athygli á því að vegna þess að sjókvíaeldi getur eingöngu farið fram hér við land fjarri helstu laxveiðiám sé staðan að þessu leyti allt öðrur en í fynsum öðrum löndum þar sem eldisvæðin séu „rétt í miðli ákaegð við helstu laxveiðiár".

### „Lítill hluti strokulaxa nær að synda upp í ár til að hrygna"

Í sömu skýrslu segir einnig: „Það verður þó að hafa í huga að aðeins lítill hluti strokulaxa nær að synda upp í ár til að hrygna. Langflestir strokulaxar eiga í erfiðleikum með að afla sér fæðu í villtri náttúru eða forðast afræningja. Afkomumöguleikar þeirra ráðast verulega af nálægð sleppistaðar við árósa og einnig af aldri við strok. Almennt má þó segja að langflestir strokulaxar hverfi í hafi og syndi aldrei upp í ár til að hrygna."

### Vöktun við veiðiár

Til viðbótar við þetta hafa laxeldisfyrirtækin lagt til, að fram fari vöktun við laxveiðiár svo að koma megi í veg fyrir að eldislax valdi tjóni. Slíkt fyrirkomulag er þekkt til að mynda í Noregi og hefur gefist vel. Fram kom í máli Kevins Glover, prófessors við Björgvinjarháskóla í Noregi, á fundi Erfðanefndar landbúnaðarins nýverið að um þetta er gott samstarf á milli laxeldisfyrirtækjanna og laxveiðiaðilanna. Því verður ekki tríað að hið sama verði ekki uppi á teningnum hér, enda fara hagsmunirnir þarna augljóslega saman.

### Fiskeldi er komið til að vera

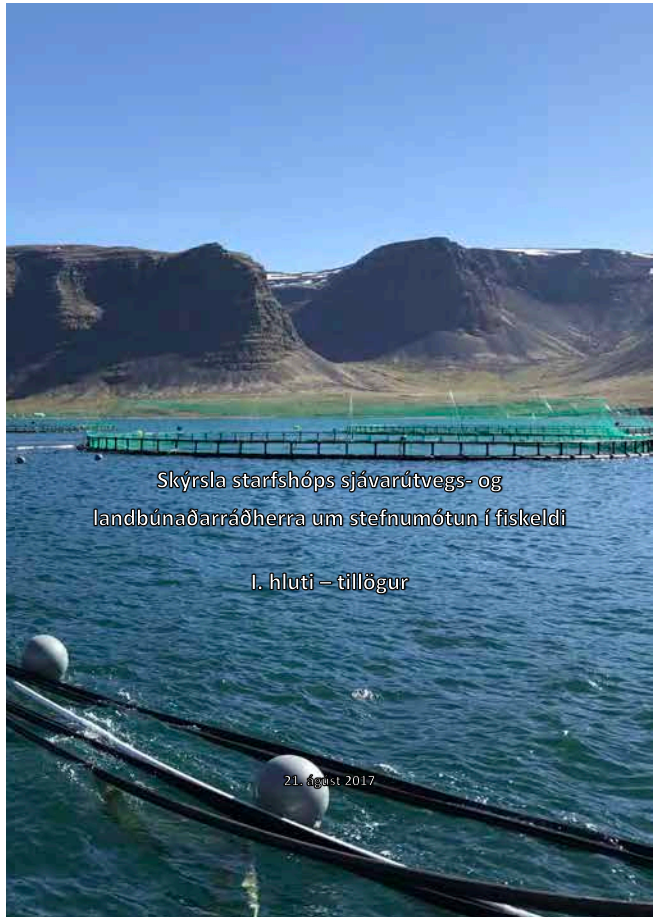
Það er ljóst að fiskeldi hér á landi er komið til að vera. Um fjögur þúsund íbúar munu hafa afkomu af fiskeldi og afleiddum störfum þegar það verður komið upp í þau 71 þúsund tonn sem áhættumat Hafrannsóknastofnunar gerir ráð fyrir, eins og sést af skýrslu sem Byggðastofnun vann um byggðaleg áhrif fiskeldis og gefin var út 23. ágúst sl.

### Í sátt við náttúruna

Samnarlega þarf að standa vel að verki og vinna í góðri sátt við náttúruna, þar með talið villta laxastofna. Til þess stendur vilji laxeldismanna sem sameiðfíust um það með veiðiréttareigendum og fulltrúum sjávarútvegs- og landbúnaðarráðuneyta og umhverfisráðuneyts, að „hamtíð fiskeldis skuli grundvallast á vísindalegum rannsóknum, eldistilraunum og vöktun í ám". Og enn fremur: „mikilvægt sé að íslensku fiskeldi séu skópuð bestu möguleg skilyrði til uppbyggingar og verði þannig sterk og öflug atvinnugrein."

# The committee on the aquaculture strategy in Iceland

- The Minister of Fisheries and Agriculture appointed a committee in November 2016 to propose the strategy for aquaculture in Iceland.
- The committee included 2 members appointed by Iceland Aquaculture Association, 1 member appointed by the Federation of Icelandic River Owners, 1 member appointed by the Ministry for the Environment and Natural Resources, in addition to the committee chair from the Ministry of Industry and Innovation, and 1 member from Matís (Icelandic Food and Biotech R&D institute).
- The committee published its report on August 21, 2017.

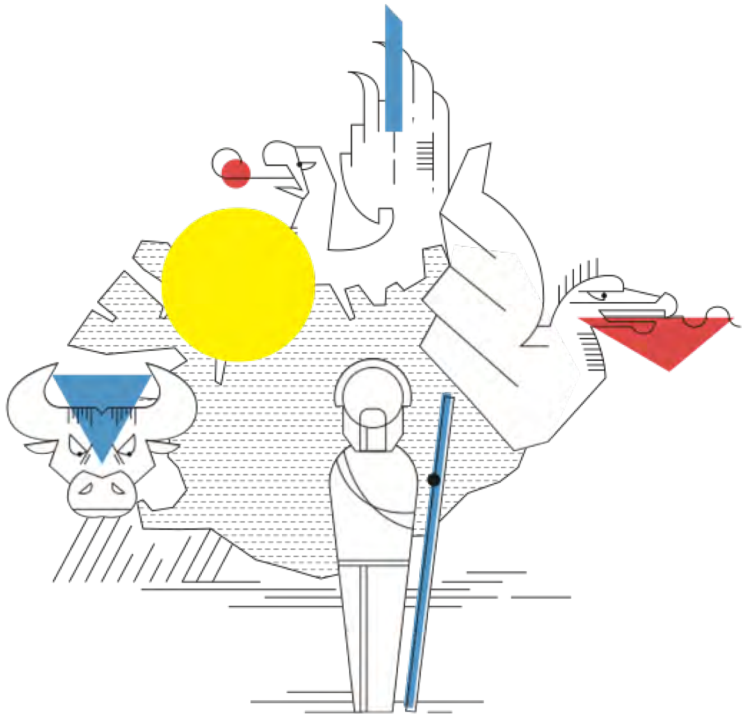


# Foundation for the proposed changes

- To build on purpose of the Aquaculture Act No. 71/2008 as outlined in article 1:
- “to create the conditions for the development of aquaculture and thus create employment opportunities and promote rural development, promote responsible aquaculture and ensure the protection of wild stocks for exploitation.”

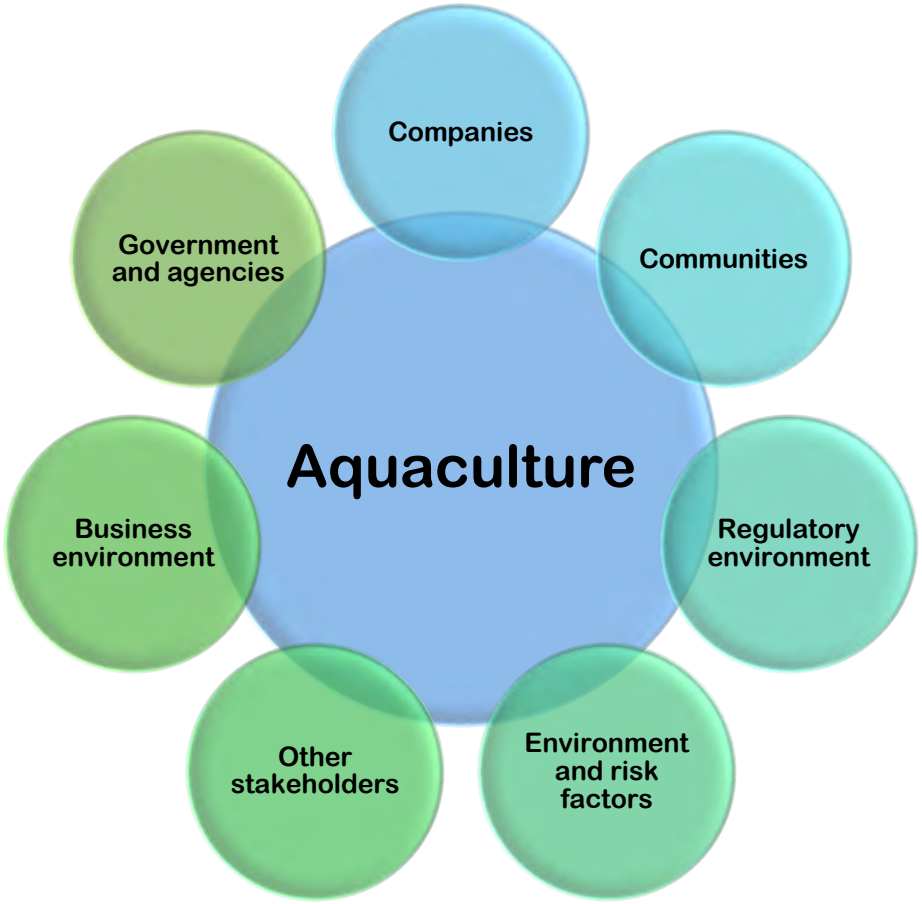
- This is the framework that sets the boundaries of the proposed changes.

# AGREEMENT between the Progressive Party, the Independence Party and the Left Green Movement on collaboration in a coalition government and reinforcing the capacity of the Althingi



**“Fish farming is a growing industry that presents opportunities for greater employment, but it must be developed with the utmost caution and in accordance with scientific advice so as not to jeopardise biological diversity. In step with the growth of the industry, measures must be taken to ensure necessary studies and monitoring of the impact on the living environment, and the future arrangement regarding licensing fees must also be discussed.”**

# The many aquaculture challenges and stakeholders



# The main players

ATVINNUVEGA- OG NÝSKÖPUNARRÁÐUNEYTIÐ

**Ministry of Industry and Innovation**

UMHVERFIS- OG AUÐLINDARÁÐUNEYTIÐ

**Ministry for the Environment and Natural Resources**

MAST Matvælastofnun Icelandic Food and Veterinary Authority

**The Icelandic Food and Veterinary Authority (MAST)**

ENVIRONMENT AGENCY OF ICELAND

**The Environment Agency of Iceland (UST)**

FISKISTOFA

**The Directorate of Fisheries**

Skipulagsstofnun

**National Planning Agency**

MARINE & FRESHWATER RESEARCH INSTITUTE

**Marine and Freshwater Research Institute (MFRI)**

# Risk assessment by MFRI

- Risk assessment was made to evaluate how much salmon farming could be operated in Iceland without taking too high risk of genetic deterioration of the wild salmon populations.
- Published in July, 2017.


HV 2017-027
ISSN 2298-9137

HAF- OG VATNARANNSÓKNIR
*MARINE AND FRESHWATER RESEARCH IN ICELAND*

Áhættumat vegna mögulegrar erfðablöndunar milli eldislaxa og náttúrulegra laxastofna á Íslandi

Ragnar Jóhannsson, Sigurður Guðjónsson, Agnar Steinarsson og Jón Hlöðver Friðriksson

REYKJAVÍK JÚLÍ 2017

# The key changes likely to be enacted

- Risk assessment to be introduced as an additional control mechanism to ensure protection of wild salmon.
  - Licenses to be conditioned on how much non-sterile salmon can be produced.
- Changes to how aquaculture sites are determined taking into account carrying capacity and the best use of resources.
- Changed rules concerning the issuance of new licenses for sites where the carrying capacity has not been determined. These licenses to be issued to the most desirable bidder.
- New and stronger control measures.
- Temporary research licenses.
- Increased transparency of aquaculture information.
- Introduction of administrative fines for non-compliance.
- Changes to taxation and fees to be introduced.

# Althingi will now have its say on the final outcome

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# Farmed- and wild salmon in perfect harmony

2018 Salmon Summit, Reykjavik

Rögnvaldur Guðmundsson, CEO


„This is the future“

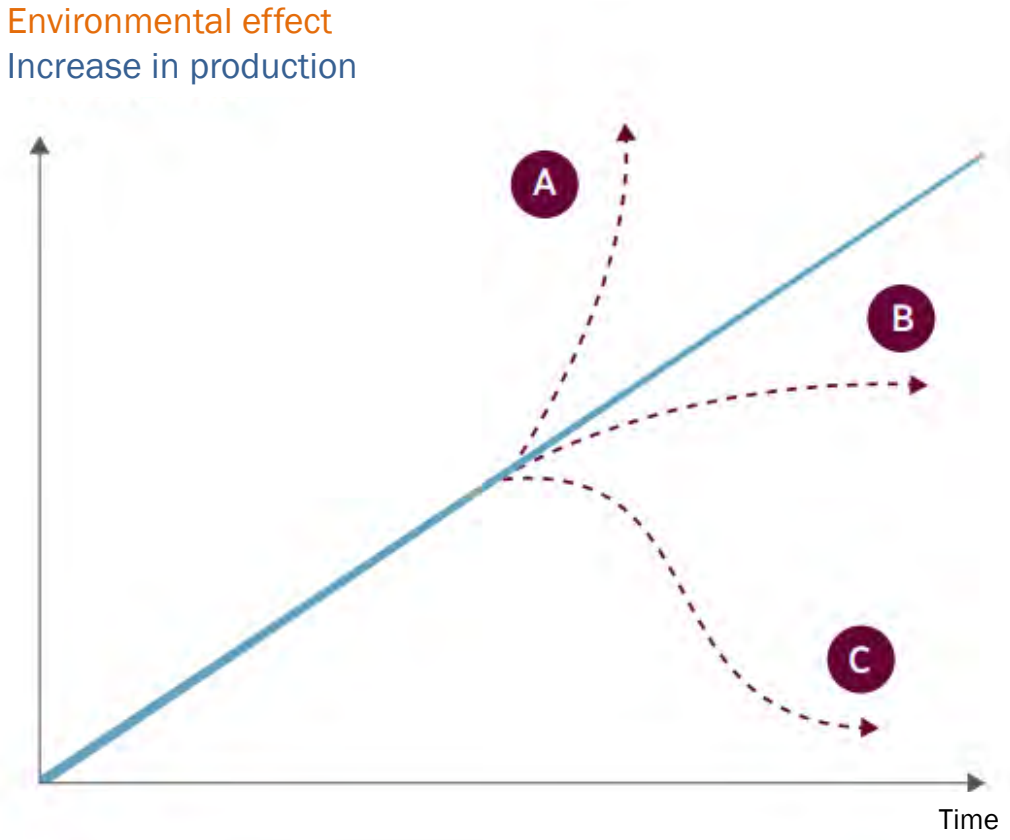
- Negative effect on the environment hinder growth in fishfarming in the world
- We need to encourage reconsiliation between stakeholders
- Authorities must regulate the industry to encurage fishfarmers to develop new, sustanable and environment friendly thecnology

akvafuture

# „Roadmap for Norwegian Fishfarming“

## Marine Harvest and Norsk Industri

### By 2030, fishfarming must posess technology to prevent salmon lice, escapes, and significantly reduces biological waste into the ocean




A: Negative environmental effect increase with increased farming with current technology

B: Mitigation reduce negative enivironmental effect

C: New Thinking – new equipment will minimize negative enviromental effect!

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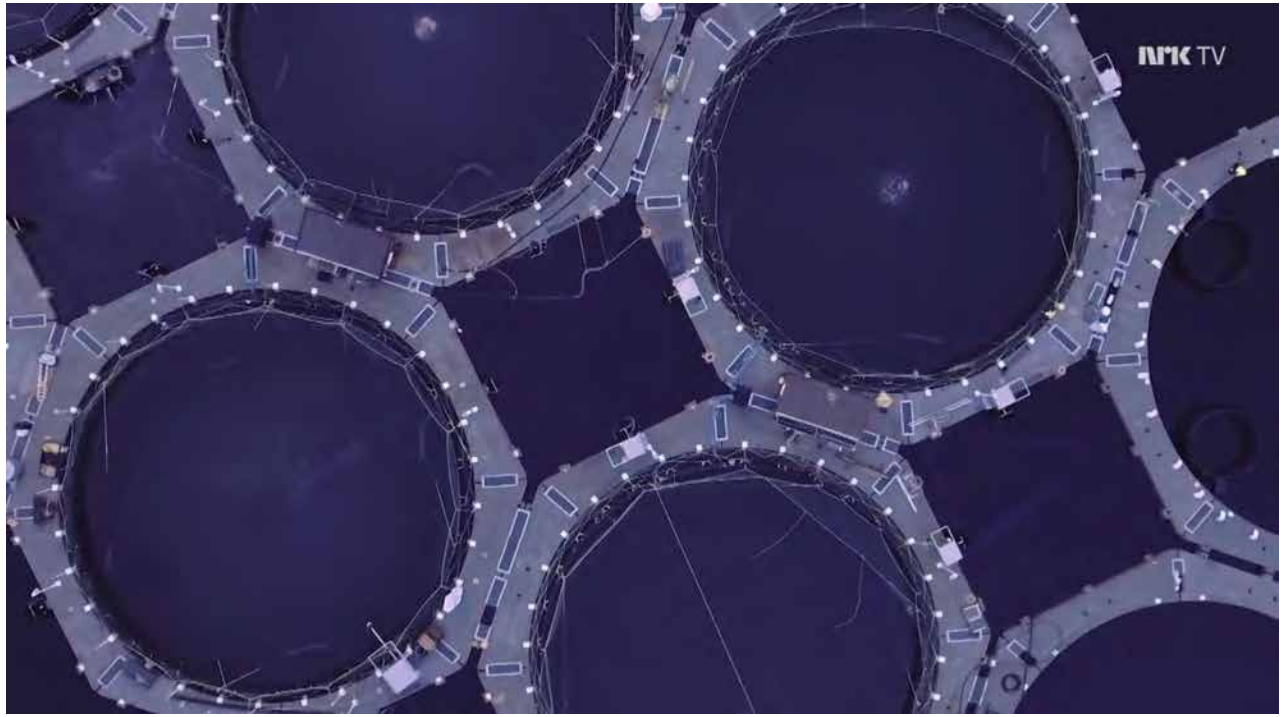
# Fishfarming in Closed Cages – Enviromnentalli friendly and sustainable

- *No Salmon Lice*
- *Significantly Reduced Risk of Escapes*
- *Higher Yield of Feed*

- *Significantly Reduced Loss of Fish*
- *Superior Quality of the Product – Less Fat – Fit Fish!*
- *Reduced Discharge of Organic Waste in the Sea – Up to 70% of Waste Pumped Ashore*




akvafuture

# Support from stakeholders

- Norwegian Salmon Rivers (Norske Lakseelver)

Vegard Heggem (*Project Manager*):

***„The salmon produced in closed cages from AkvaDesign does not threathen the wild salmon“***


- Green Warriors of Norway (Norges Miljøvernforbund)

Kurt Oddekalv (*President*):

***„This is a technology that all salmonfarmers should use“***

- Norwegian Coastal Fishermen (Norges Kystfiskarlag):

***„The interests of coastal fisheries is taken care of with this technology“***

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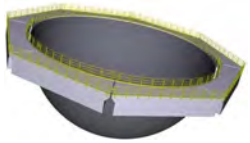
# From Idea to Reality



Personnel

32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

1997

2007

2011

2012

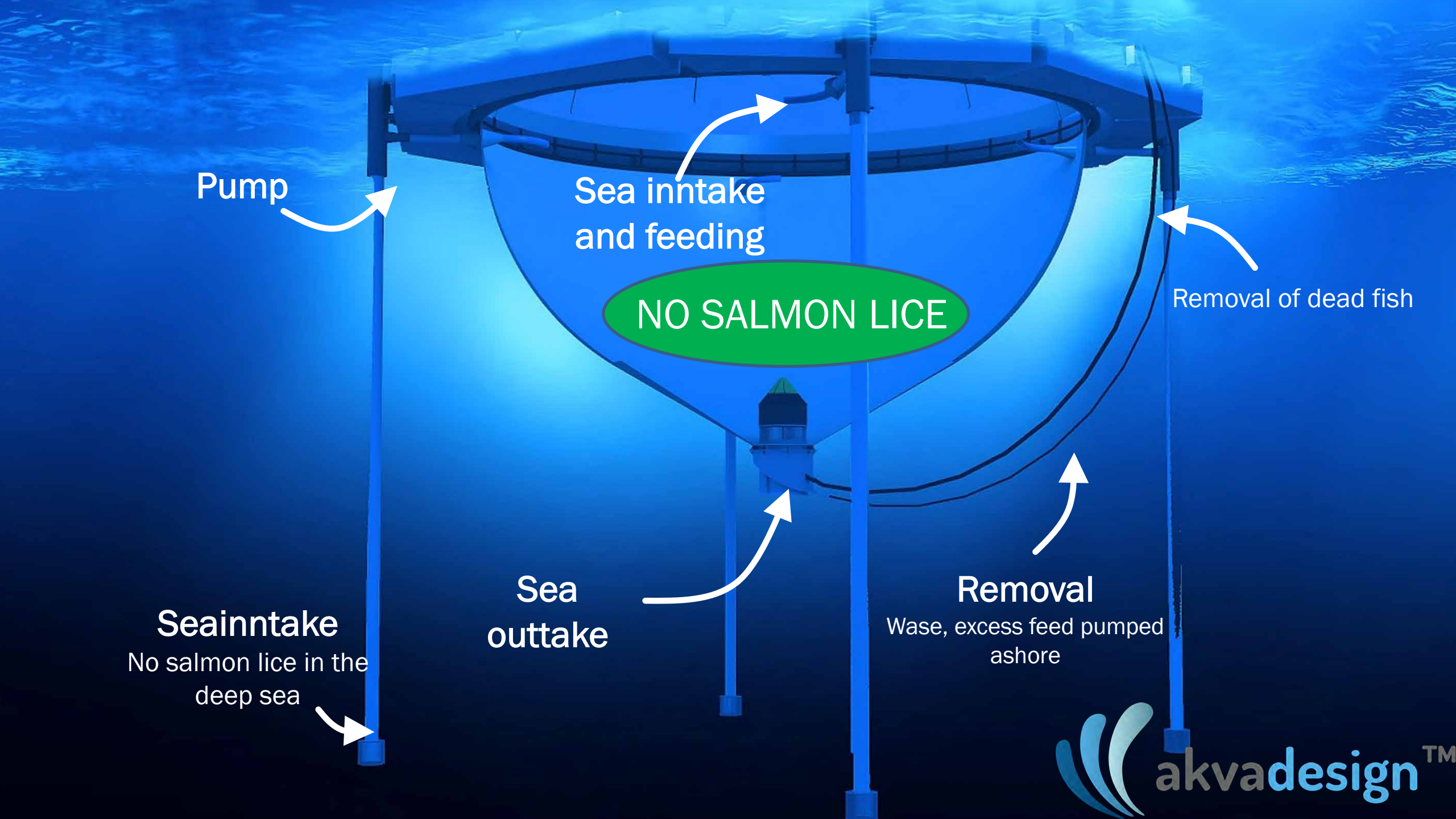
2013

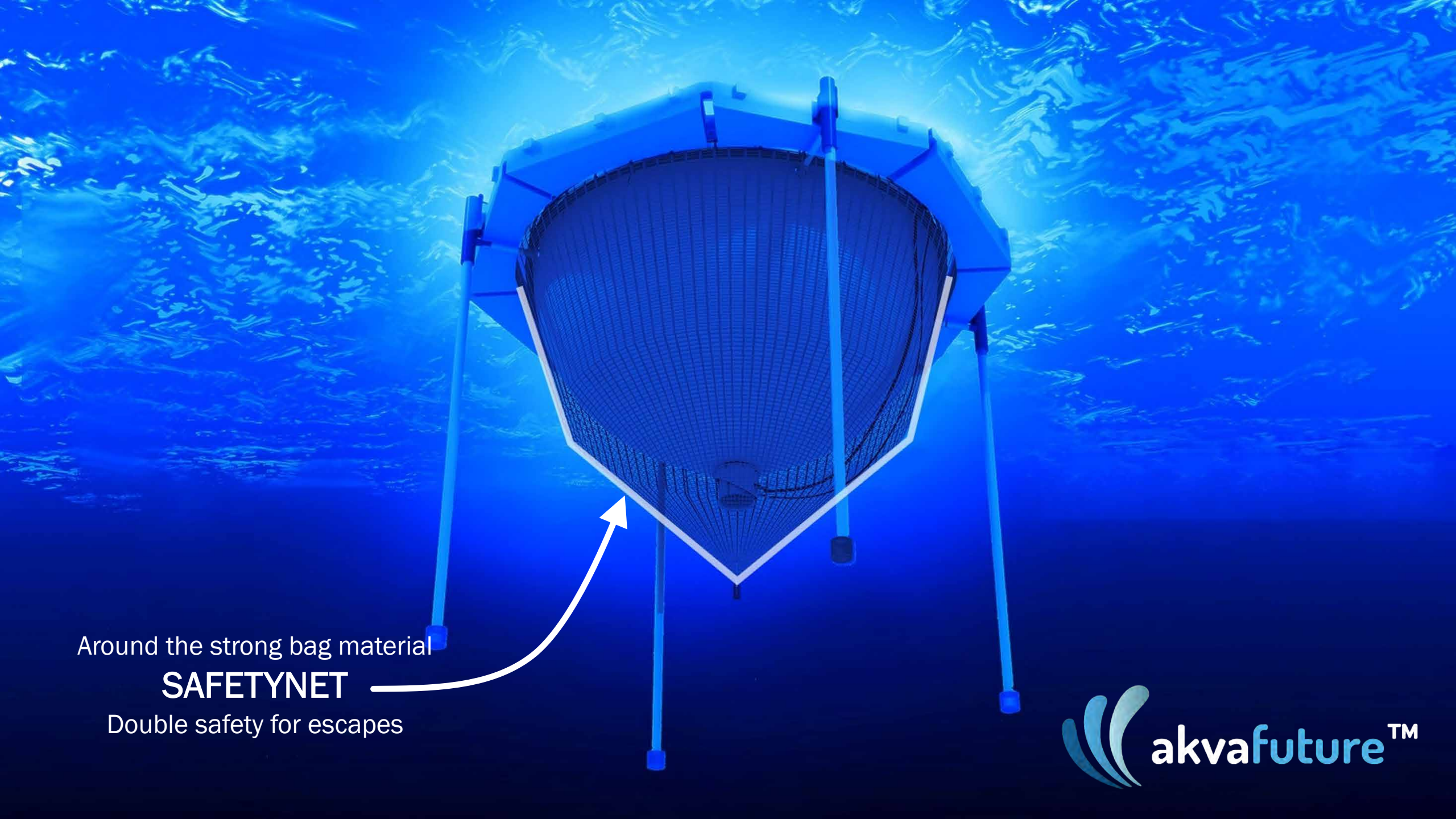
Environmental Price from the Norwegian Fisheriesminister

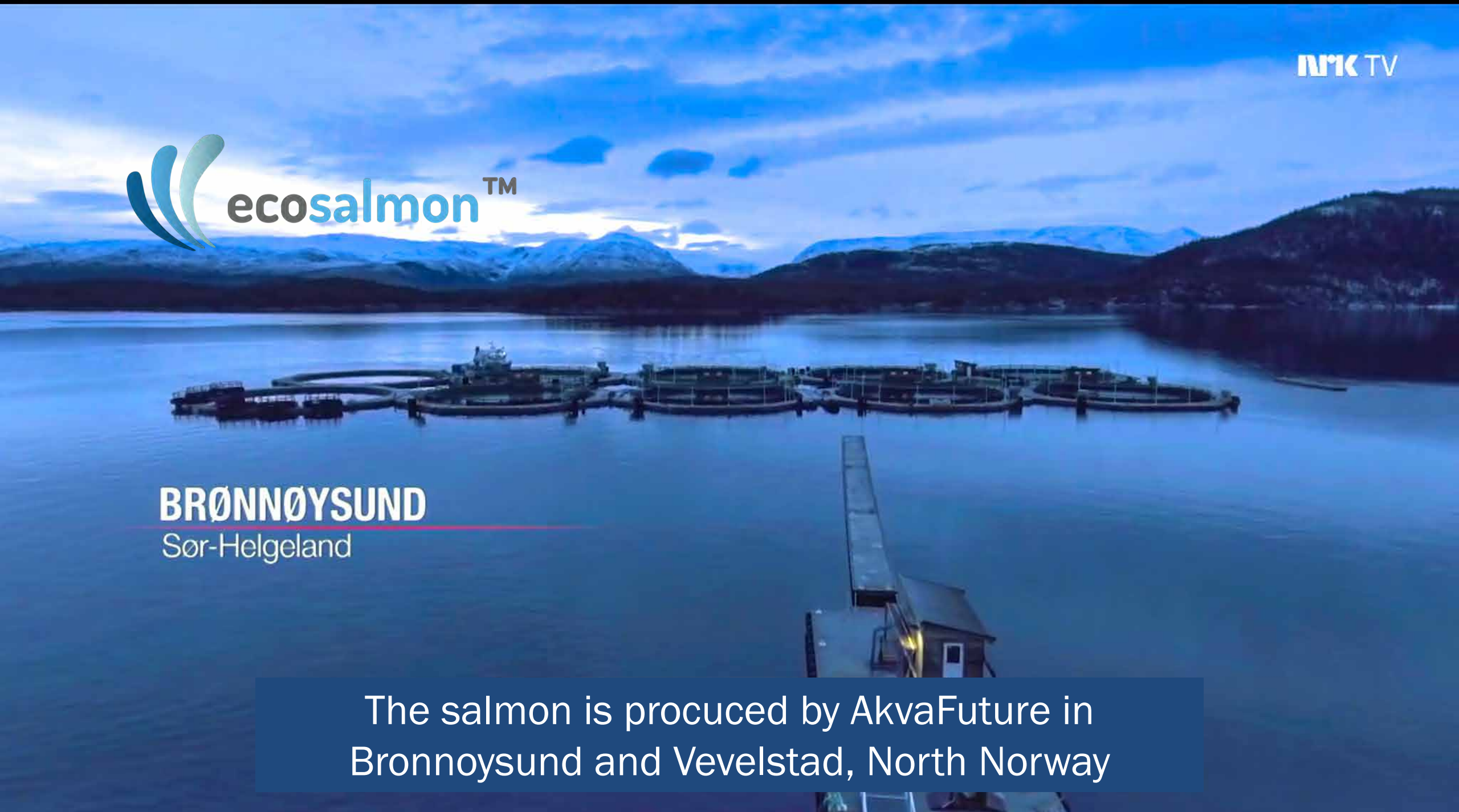
March 2016

August 2017

December 2017


Pump
Sea inntake
and feeding
NO SALMON LICE
Removal of dead fish
Sea
outtake
Removal
Wase, excess feed pumped
ashore
Seainntake
No salmon lice in the
deep sea
akvadesign™


Around the strong bag material
SAFETYNET
Double safety for escapes
akvafuture™




The salmon is procuced by AkvaFuture in Bronnoysund and Vevelstad, North Norway

AKVATECH®

SUSTAINABLE AQUACULTURE

# 2018 Salmon Summit, Reykjavik

Geir Spiten, CEO Akvatech

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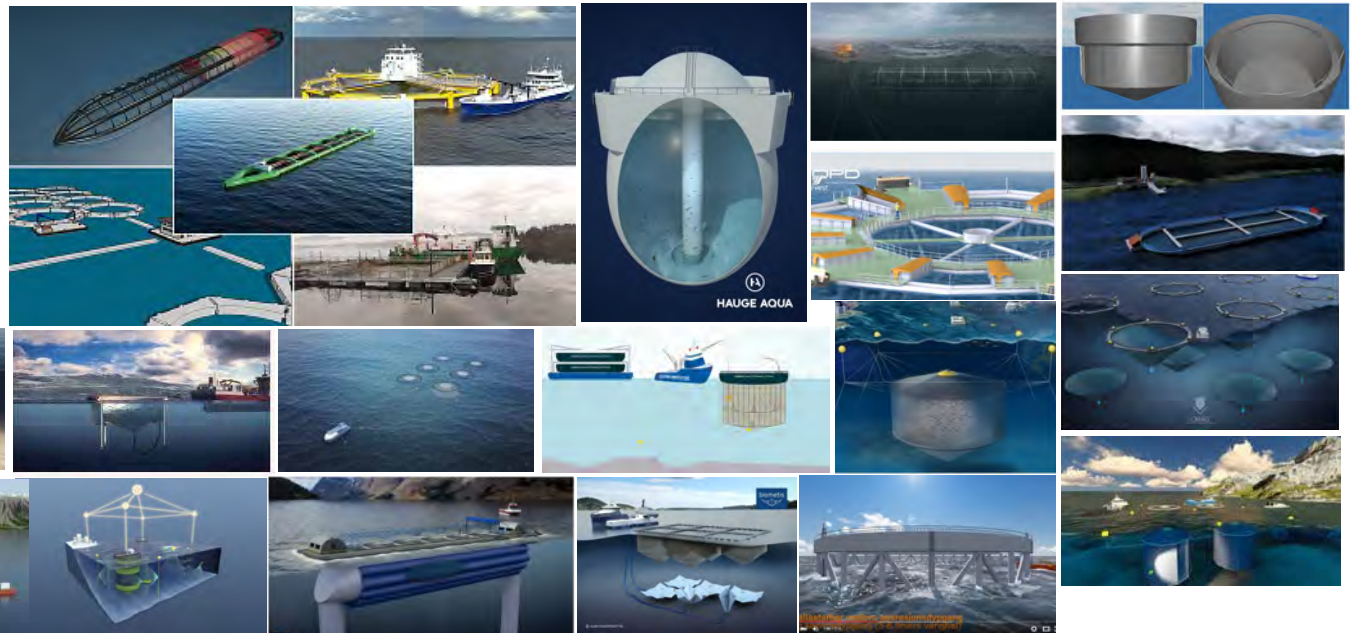
## Norway - technology concepts…

**Some of the 104 technology concepts announced asking for new development licenses in Norway**






**Source:** Public Information, Akvatech analysis

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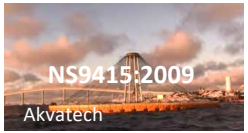
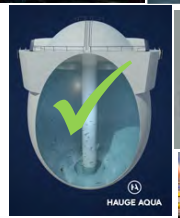
## ..may in the future taking place …

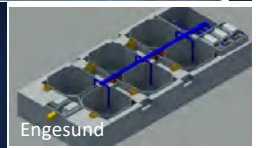
# Floating sea based Closed Containment System (CCS) for salmon farming operations





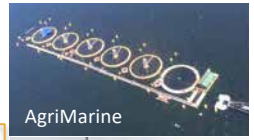



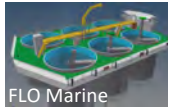









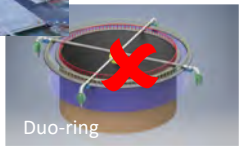


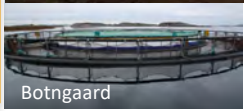


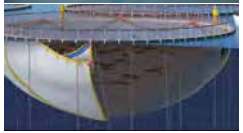


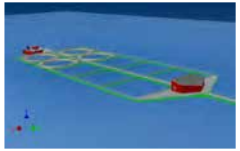






| | |
|---|---|
| NS9415:2009 | Approved according to NS9415:2009 |
| ✓ | Approved development concessions concept |
| ✗ | Denied development concessions concept |



**Source:** Public Information / Akvatech analysis

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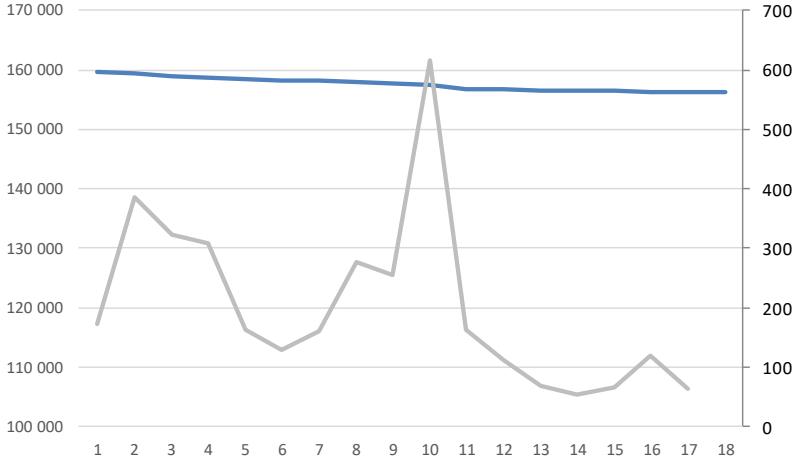
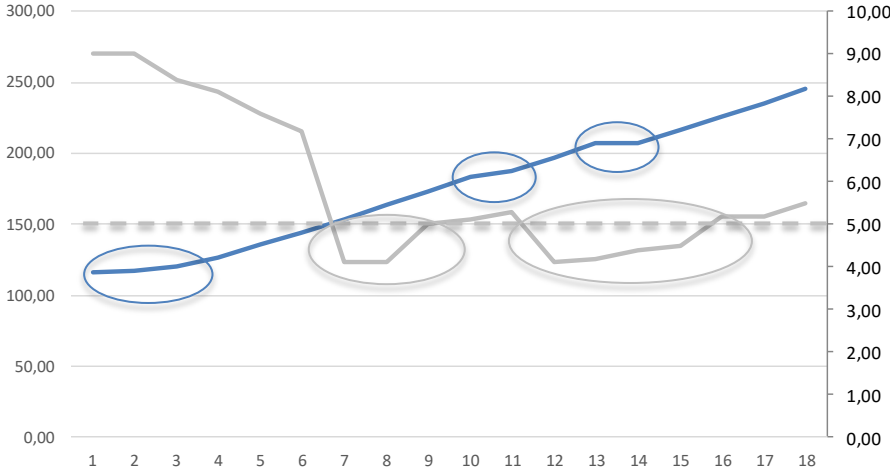
# Experience Norway – post smolt in sea based closed containment system




**Primary**, total number of fish (159 610). Total mortality 2,15% of outset (3 434)

**Secondary**, mortality per week




**Primary,** weight/gram. The blue line shows the actual growth per week. Non feeding periods, 5 of 18 weeks (blue circles)

**Secondary,** Celsius degrees. Gray line average temperature per week. Gray dotted line; five degrees which is considered to be around lower limit regarding feeding. Grey circles indicates periods below five degrees (8 of 18 weeks)

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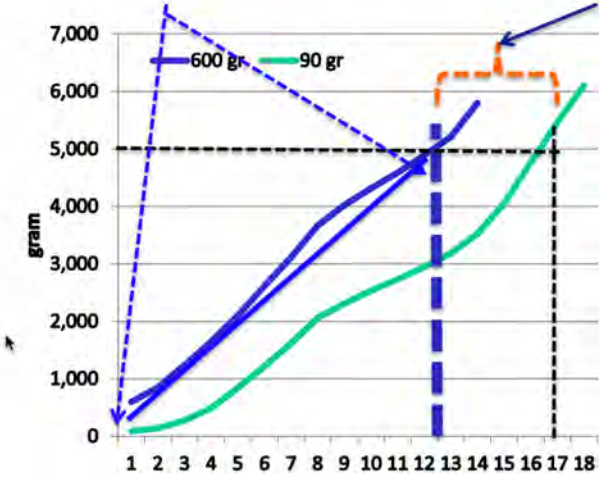
## Experience Norway

# Kinder surprise…


Experience 2017 closed containment **better than expected**




From 220 til 5000 grams in 12 months!

- Lower start weight
- Quicker growth

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## NS9415:2009 Certified products in operation …

| | Open net pen | Closed containment (post smolt production) |
|---|---|---|
| Mortality | 15-20% | 1-2% |
| Feed conversion ratio (FCR) | 1,3-1,4 | 1,0-1,1 (and below 1,0) |
| Prod. Time (moths) | 18-22 | 3-6 in SCCS + < 7-11 open net pen (with 6-12 NOK reduction in cost per kilo grown out) |



**Source:** Norsk Industri / Sterner / Akvatech analysis

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SUSTAINABLE AQUACULTURE

# Going forward from todays open net pens ...

## From…


## …to…


*** Norwegian Industries**
The federation represents more than 2,400 member companies with approx. 126,500 employees. Member companies' interests are the Federation's main focus. The Federation of Norwegian Industries engages in the most important industrial and business policy issues of the day.



**Source:** Norsk Industri / Akvatech

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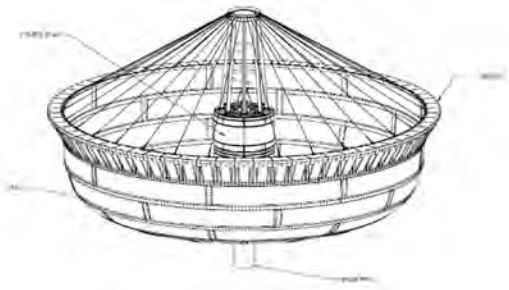
## Closed Containment System

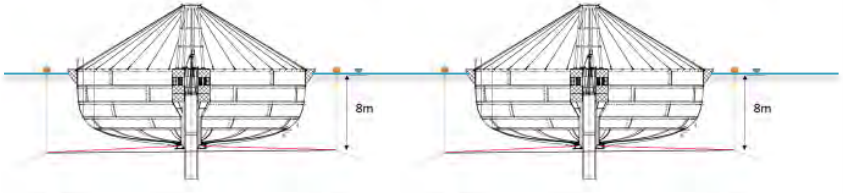


A floating Closed Containment System ("CCS") with solid-wall for salmon, trout, and other schooling finfish.

System components include pump, oxygenator, monitoring, and solid waste removal.

Harvesting and grading operations are easily accomplished from the perimeter walkway and center platform.

NS9415:2009 certified product




**1 x 3 000 m³ CCS operation**
**Gullklakken, Smøla, Norway**

**Assembly, launch and towing**
**BOAS, Averøya, Norway**

**6 x 3 000 m³ CCS operation**
**Lois Lake, BC, Canada**

**6 x 3 000 m³ CCS operation**
**Benxi, China**

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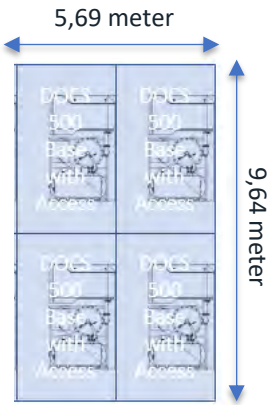
## Proven technology - barge and/or land base – Oxygen production




**7xDOCS 500, Oxygen Utility Barge**
**Vancouver Island, Canada**
**25 psig (1.9 barG)**

**2xDOCS 500, Containerised Installation**
**Campbell River, BC, Canada**
**55 psig (3.8 barG)**

Source: PCI Gases (www.pcigases.com )

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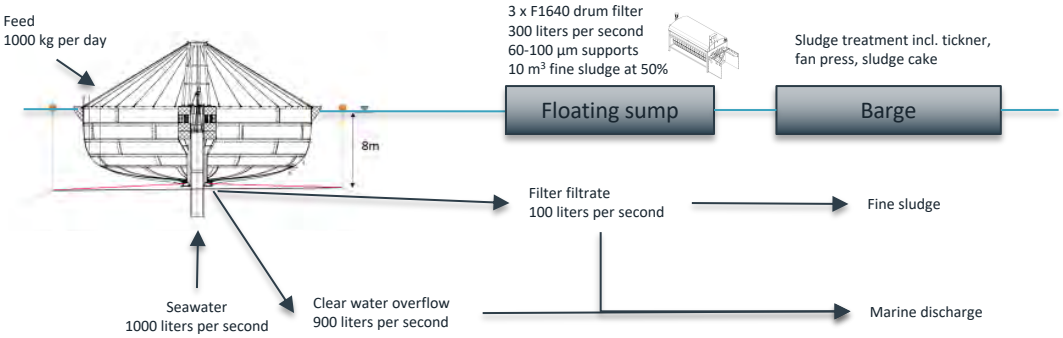
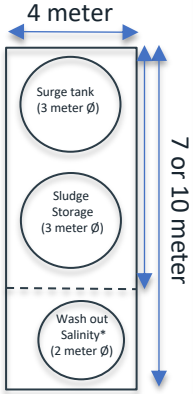
## Waste treatment




*Need to take out salinity before processing – this part of the process will take place at land base.

Sterner sludge treatment process with production of biogas.
Containerised Installation
Smøla, Norway

Source: Sterner AS (www.sterneras.no)

The floating closed containment units going to be supported from one barge

All figures are based upon one unit

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SUSTAINABLE AQUACULTURE

# Going forward – available now..

## ...future...


## ...available now

1 x 3 000 m³ CCS operation
Gullklakken, Smøla, Norway

Assembly, launch and towing
BOAS, Averøya, Norway

6 x 3 000 m³ CCS operation
Lois Lake, BC, Canada

6 x 3 000 m³ CCS operation
Benxi, China

Sterner sludge treatment process with production of biogas.
Containerised Installation
Smøla, Norway

Source: Sterner AS (www.sterneras.no)



**Source:** Norsk Industri / Sterner / Akvatech


# Contact information

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gs@akvatech.no
+47 90 97 37 03

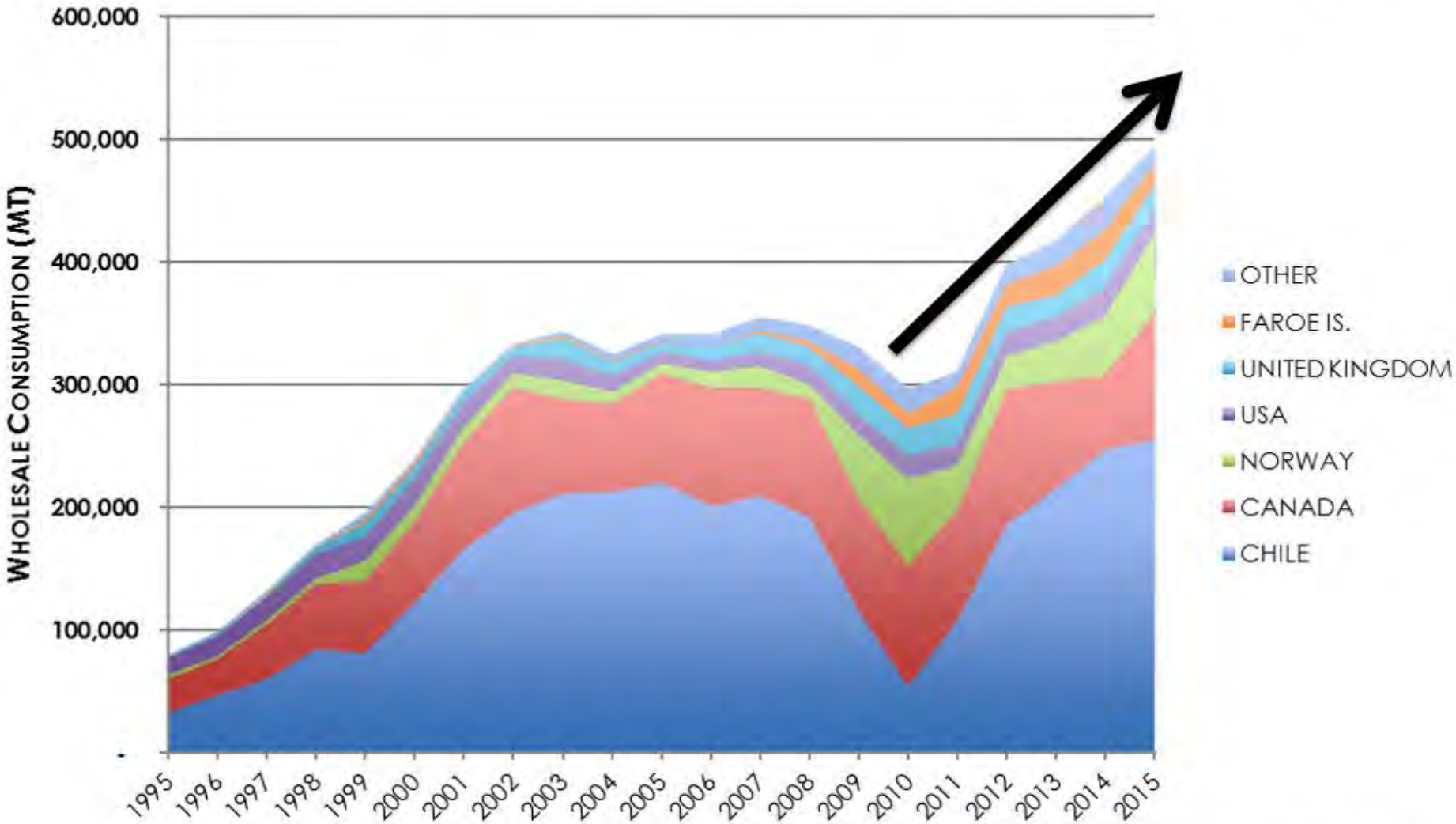
March, 2018

# Growth in Land-Based Salmon Production: Key Drivers and Project Update

**Brian Vinci**
The Conservation Fund
Freshwater Institute
USA

# Key Drivers – Market Demand

## US Atlantic Salmon Market - Volume




NMFS Atlantic Salmon Trade Data

# Key Drivers – Production Limitations

## Permitting of Net Pen Sites

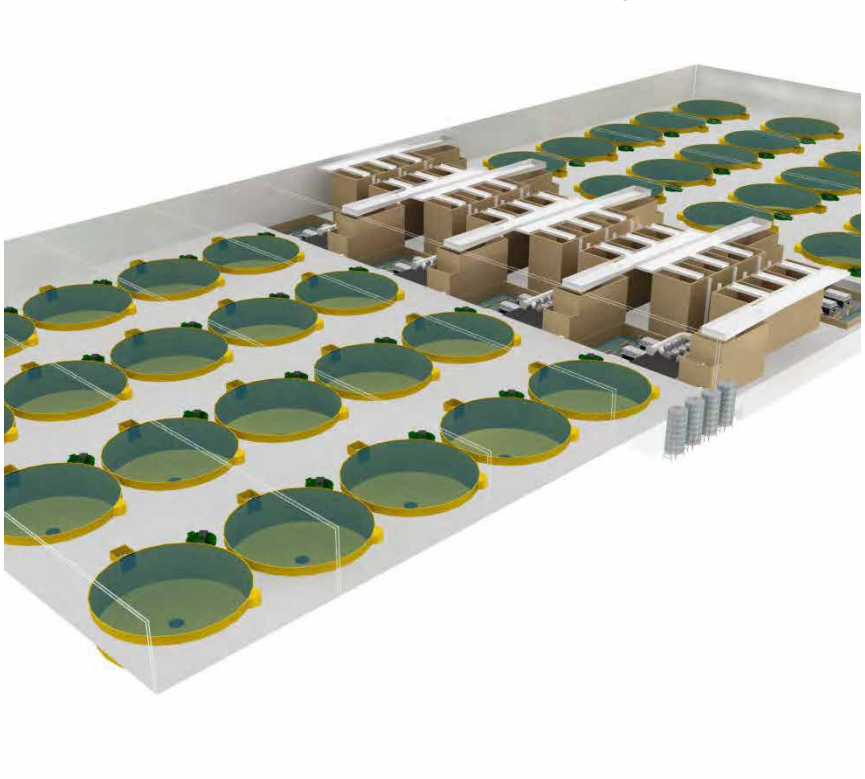
- Reduced availability of licenses
- Licenses subject to greater scrutiny
- Cost of licenses has increased

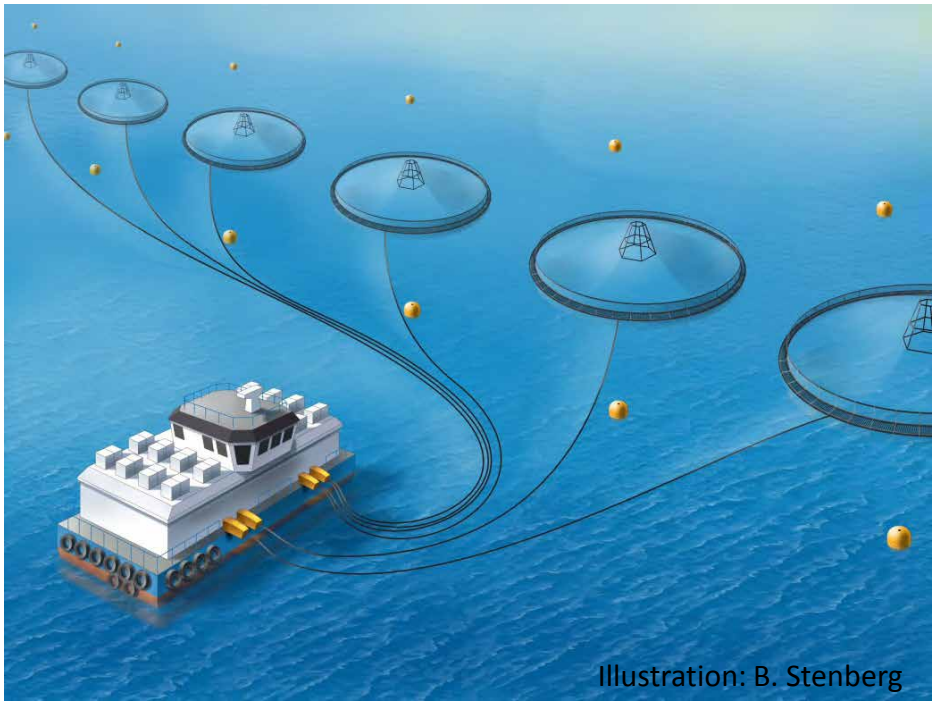
## Disease and Parasites in Net Pen Sites

- Continued reports of disease
- Direct loss & cost of treatment increase

# Key Drivers – Economics

## 4,000 MT per year



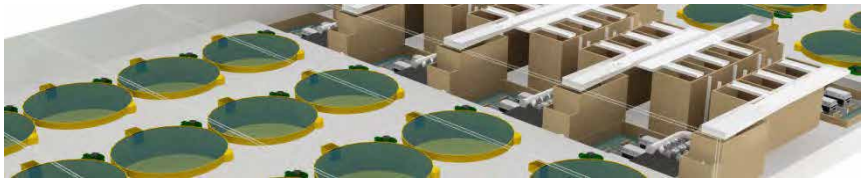


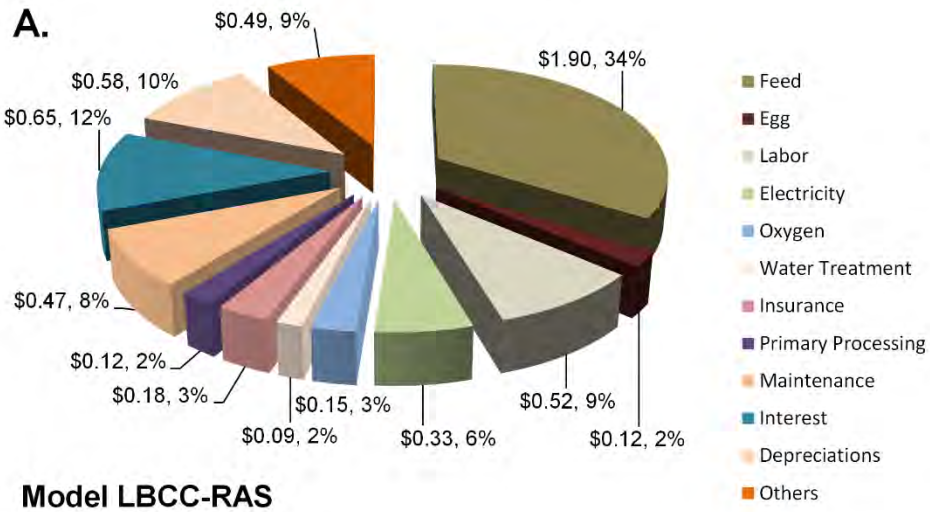

**Land-Based RAS Farm**

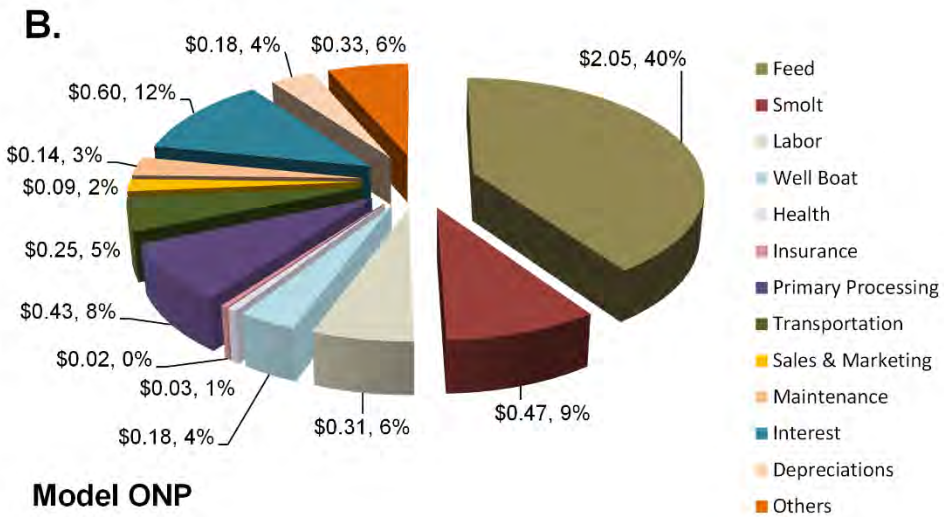
**Model Net Pen Farm**

**Liu et al. 2016**

# Key Drivers – Economics



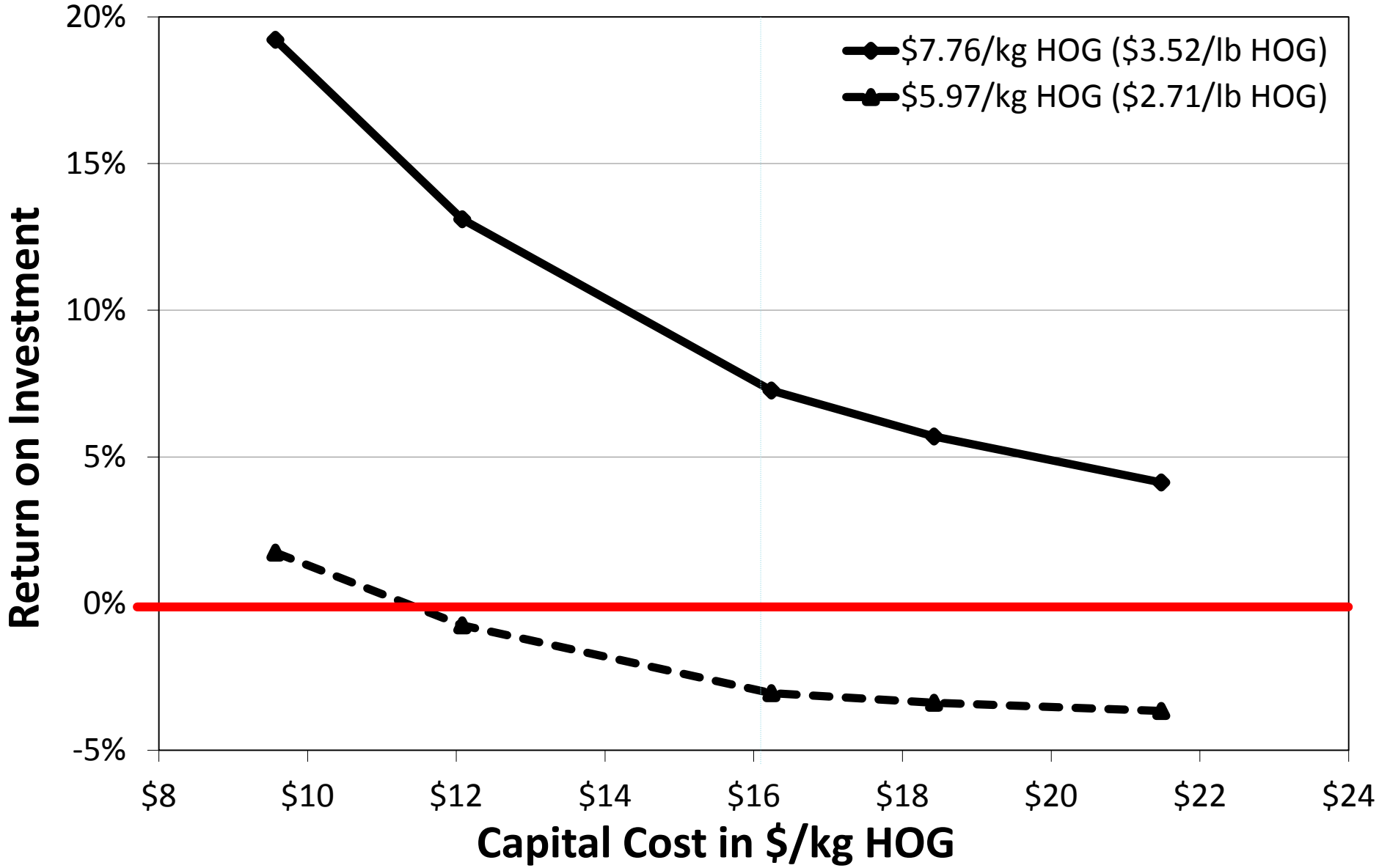


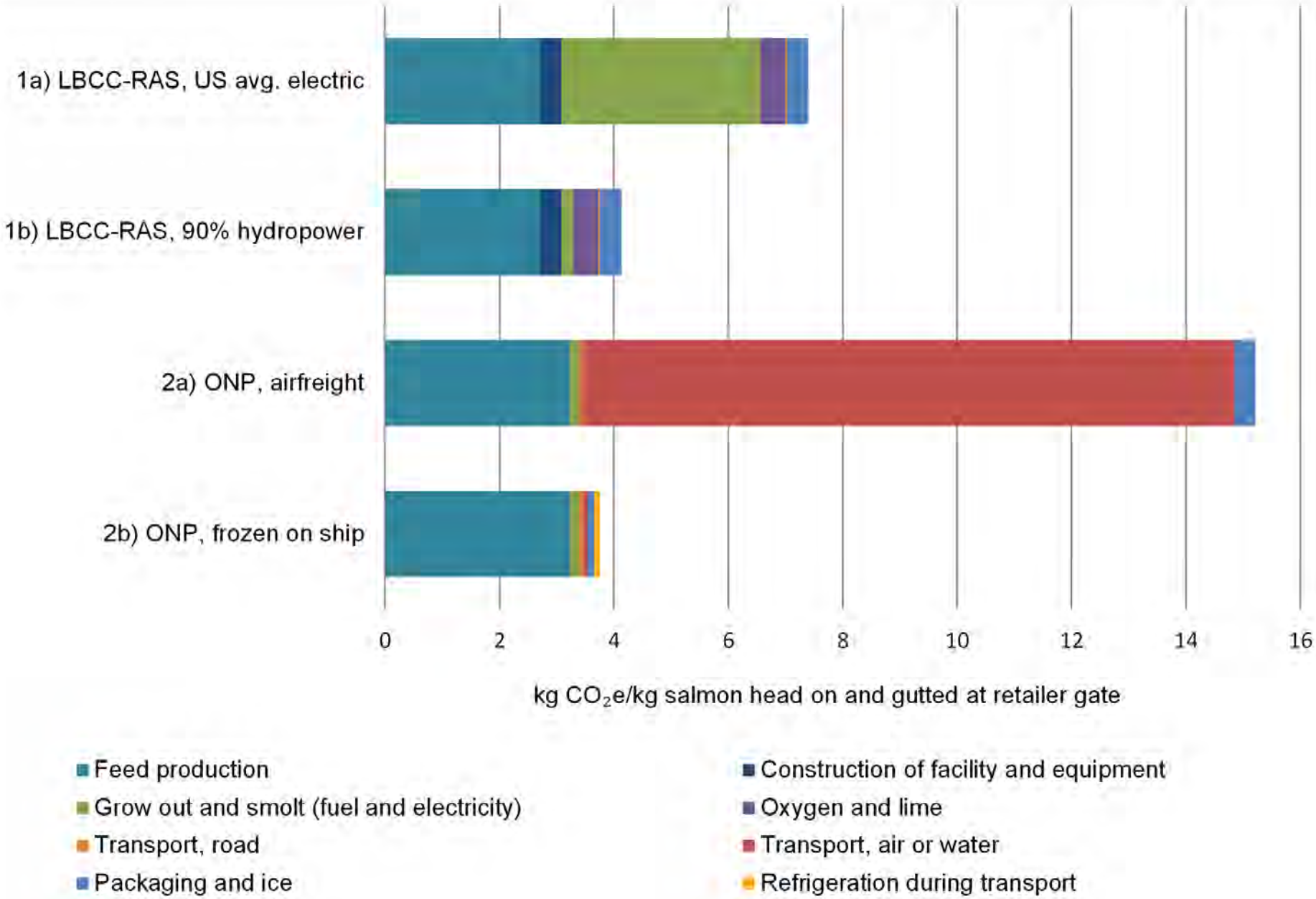

**$5.60 ($4.37) per kg HOG**

**$5.08 ($4.30) per kg HOG**

# ROI versus Capital Cost



# Key Drivers – Sustainability



# Leading Edge Salmon Projects

KUTERRA
SUSTAINABILITY HAS LANDED

SUSTAINABLE BLUE

ATLANTIC SAPPHIRE®

DANISH SALMON

JURASSIC SALMON

SWISS LACHS
pure alpine salmon

東方海洋
ORIENTAL OCEAN

# Ascent Phase Projects

ATLANTIC SAPPHIRE®

SUSTAINABLE BLUE

matorka landbased aquaculture

NORDIC AQUAFARMS
SUSTAINABLE AQUACULTURE

WHOLE OCEANS™
MAINE SUSTAINABLE SALMON

AQUABANQ

# Next Steps – The Future!

- Geir Spiten, AkvaTech
- Rognvaldur Gudmundsson, Akvafuture

NORSKE LAKSEELVER

# United for the Salmon!

*Norwegian Salmon Rivers*

Torfinn Evensen, Secretary general

Salmon Summit 22.03. 2018

# Norwegian Salmon Rivers

Organization of river owners and managers in rivers with anadromous salmonides

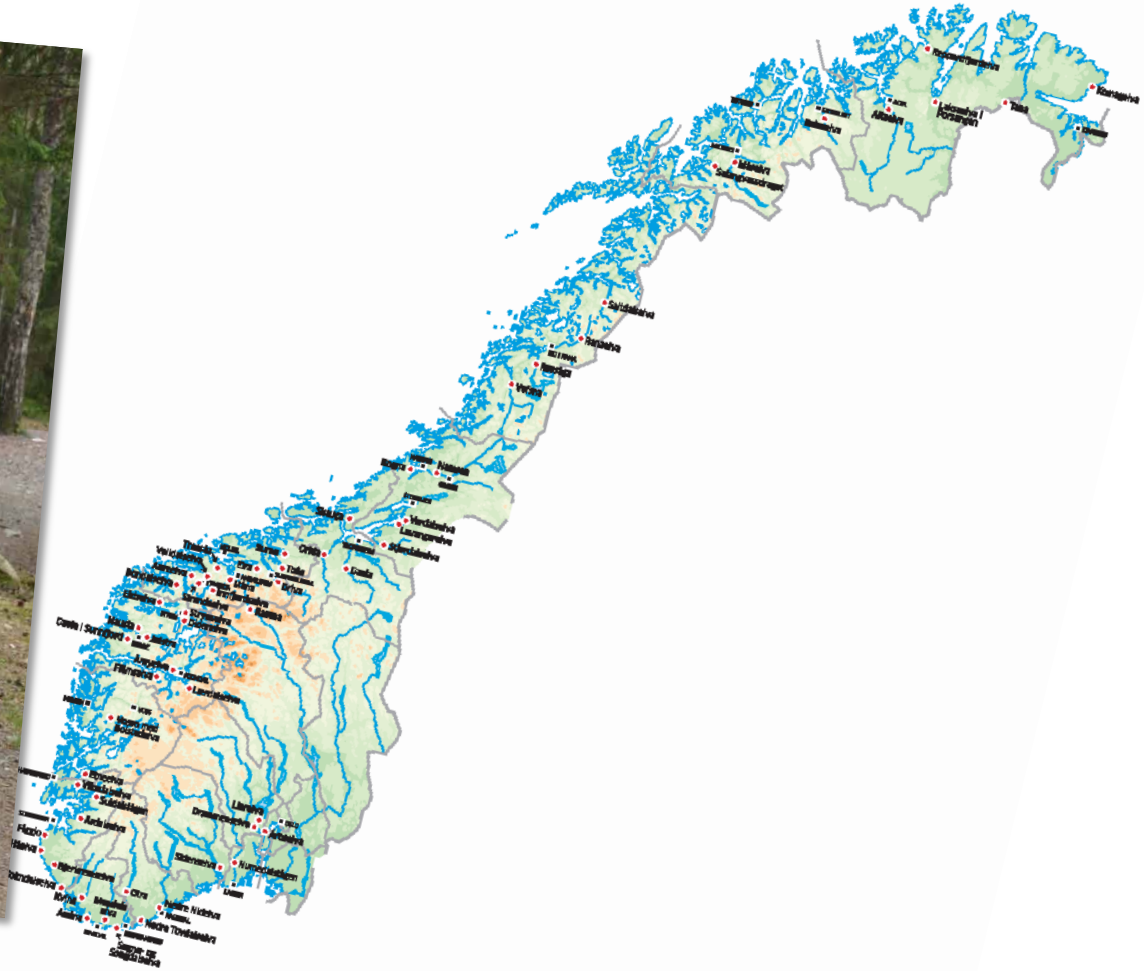
- Est. 1992
- 100 rivers
- 7000 river owners
- 70 % of all the ovners
- 5 in the staff, based in Oslo

# – *Rivers of Life!*

**Our pillars:**

- Vital stocks of fish in the rivers
- Attractive and diverce offers of Salmon angling
- Local based river management

# Salmon rivers all along the coastline



NORSKE LAKSEELVER

*- for mer liv i elva!*

# The Norwegian alliance for wild Salmon

| | | | |
|---|---|---|---|
| njff.no | NORSKE LAKSEELVER<br>lakseelver.no | WWF<br>wwf.no | NORSK FRILUFTSLIV<br>norskfriluftsliv.no |
| VIRKE HOVEDORGANISASJONEN<br>virke.no | NORGES SKOGEIERFORBUND<br>skog.no | Naturvernforbundet<br>naturvernforbundet.no | GREENPEACE<br>greenpeace.no |
| NORGES BONDELAG<br>bondelaget.no | Reddvillaksen<br>reddvillaksen.no | SABIMA SAMARBEIDSRÅDET FOR BIOLOGISK MANGFOLD<br>sabima.no | NATUR OG UNGDOM<br>nu.no |

## United we are stronger!

NORSKE LAKSEELVER

*- for mer liv i elva!*

# A wide range of organizations support the Salmon

- NASF Norway
- Anglers
- River owners
- Farmers Union
- Forest owners
- Tourism org.
- WWF Norway
- Friends of the Earth
- Greenpeace
- Outdoor org.
- Youth org.
- Bio. Diversity org.

## Task based and informal

# Main tasks in the alliance

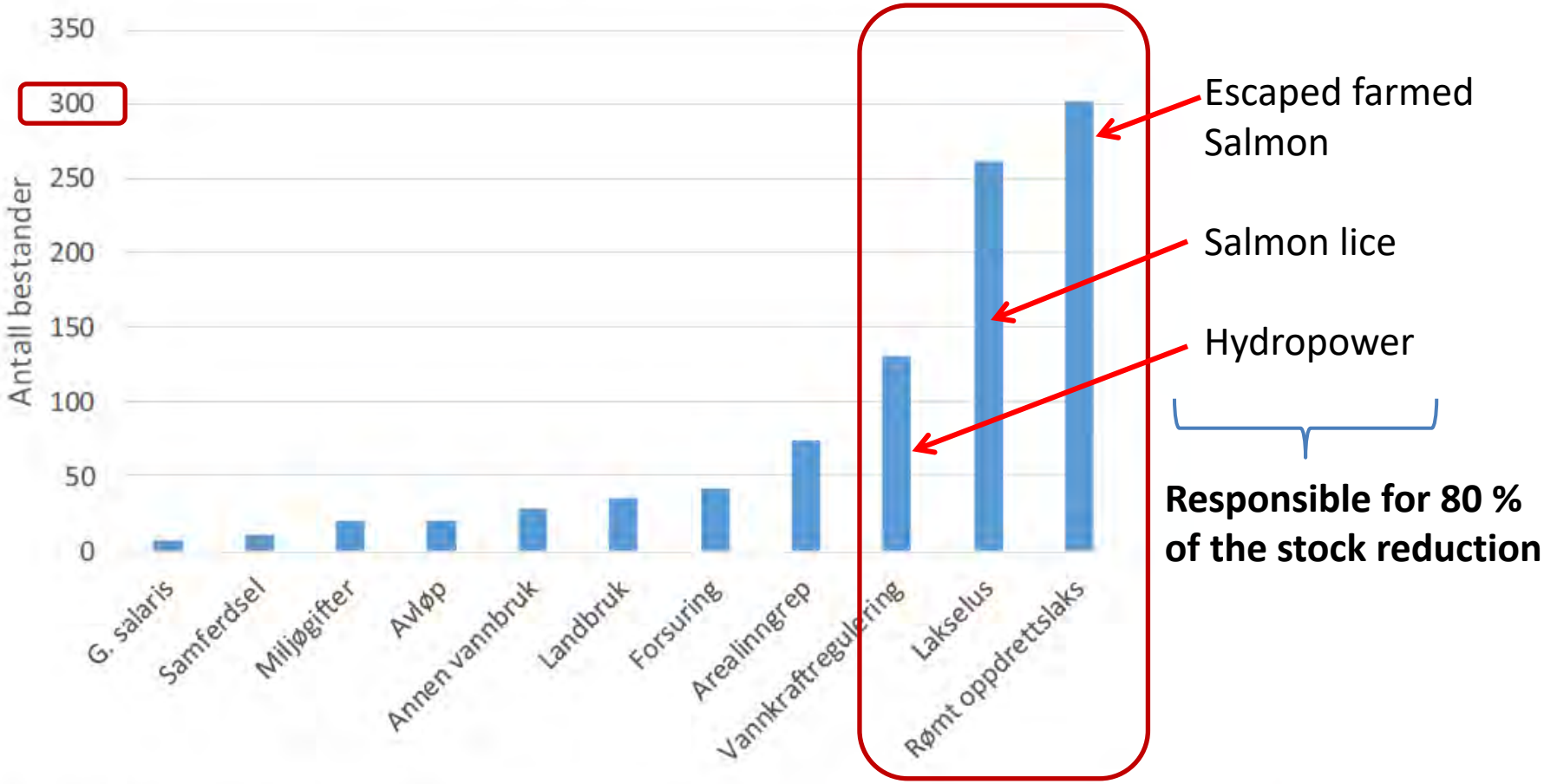
- Salmon farming industry
- Hydropower regulation

Create understanding for managing actions:

- Responible C & R-policy
- Banning of mixed stock fishery

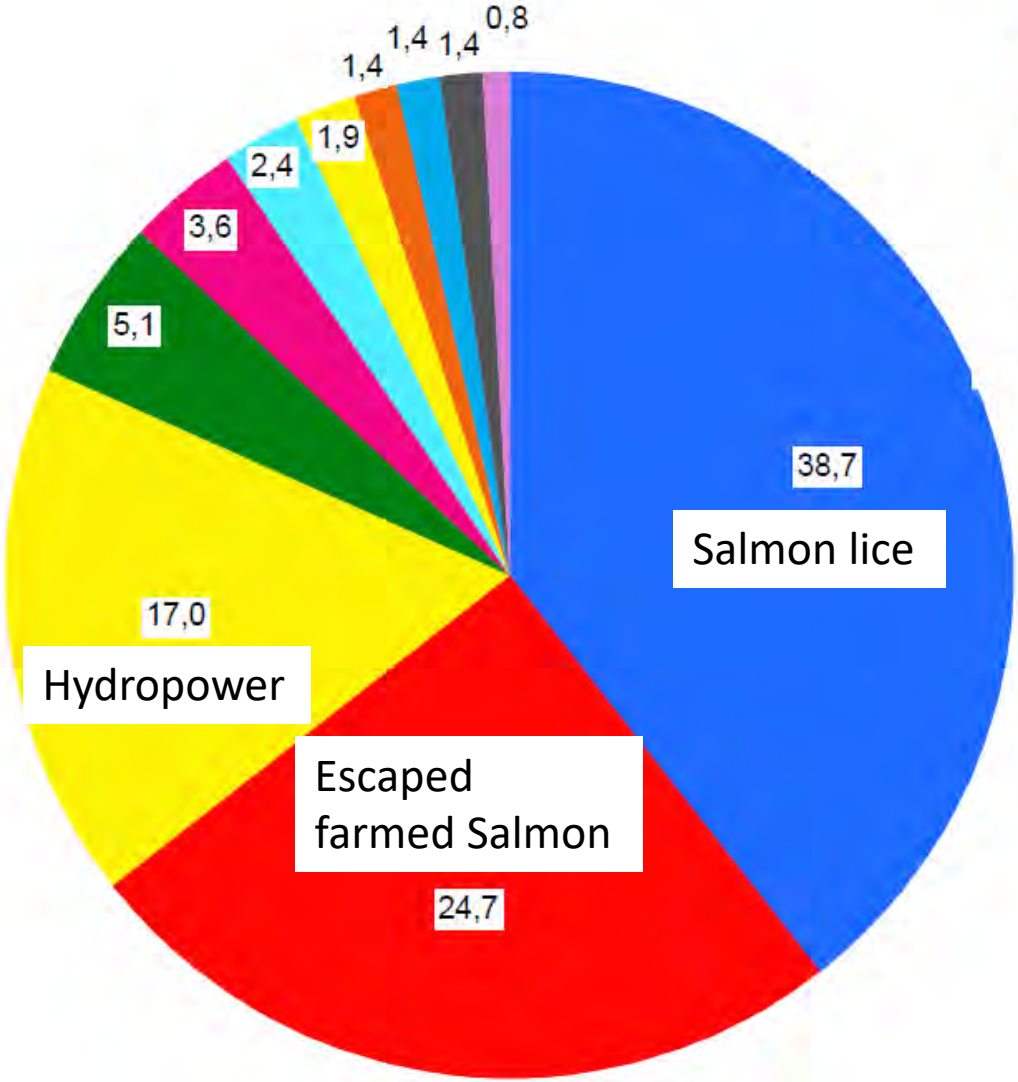
# Main threats to the Salmon

TEMARAPPORT FRA VITENSKAPELIG RÅD FOR LAKSEFORVALTNING NR. 6




***Figur 3.3.*** *Antall laksebestander som var negativt påvirket av ulike påvirkningsfaktorer for perioden 2010-2014. Totalt ble 448 bestander vurdert. Hver bestand kunne være påvirket av flere påvirkningsfaktorer.*

# Threats responsible for the Salmon stock reduction In Norway




***Figur 3.4.*** *Effekt av ulike påvirkningsfaktorer på redusert bestandsstørrelse hos norsk laks, beregnet etter prosentandel hver enkelt påvirkning utgjør av totalsummen, for perioden 2010-2014. Totalt ble 448 bestander vurdert. Tallene i figuren angir prosentandeler.*

# How do we work together?

- We all agree Salmon is an iconic species
- Salmon is an indicator for the environment

- Regular meetings -> policy documents
- Building a ”shearing” culture
  - knowledge
  - attitudes
  - nettwork
  - solutions

- Meet the autorities and politicans as a group

Per Sandberg med sin lille blå om villaks, som han fikk utdelt på seminaret i Alta i februar 2016. Foto: Øistein Norum Monsen / Dagbladet

NORSKE LAKSEELVER

# Call to the Prime minister for 3 x 0

WWF

Naturvernforbundet

SABIMA

GREENPEACE

NORSKE LAKSEELVER

Reddvillaksen.no

**Statsminister og Høyres leder Erna Solberg**

Oslo, 28. juni 2017

## Veiskille for norsk oppdrettsnæring

Norsk oppdrettsnæring er ved et veiskille hvor alt ligger til rette for å sikre en bærekraftig havbruksnæring.

Våre organisasjoner mener at det på høy tid at myndighetene nå griper muligheten og sikrer en fremtidsrettet havbruksnæring. Organisasjonene ber derfor om at Høyre i den kommende stortingsperioden prioriterer følgende grep som sikrer:

1. «3 x 0» som hovedmål - **null** lus, **null** rømming og **null** ressurser på avveie.
2. At miljøindikatoren for lakselus i trafikklyssystemet justeres slik at vekst kun gis i områder der lakselus ikke har bestandsreduserende effekt på vill laksefisk.
3. At trafikklyssystemet justeres slik at rødt lys i et område gir krav om umiddelbar nedskalering av produksjon.
4. At nye miljø- og produksjonsindikatorer innføres, slik trafikklysregimet har tatt høyde for.
5. At teknologikonsepter som gjør det mulig med «3 x 0-produksjon» prioriteres ved behandling av søknader om utviklingstillatelser.

# How do we communicate?

- Science based
- Refering to scientific papers
- Use scientists in meetings ie.
- Scenic images
- Social media

# Need for international pressure!

- The fish farm companies are multinational
- They adapt to local regaulation
- We need international standards (3 x 0)
- Authority based rather than run by the companies
- NGOs have power if we coordinate better

# How to do it?

- Norway need some international critical eyes watching
- Work case-based to bring up good examples
- Develope a more formal international NGO-network

**Show the politicans solutions by serving them farmed Salmon from cloesed containments: eat the future!**

# Int. NGOs to the Norw. Parliament

**Vedrørende Stortingets behandling av stortingsmelding nr. 16 (2014-2015) om Forutsigbar og miljømessig bærekraftig vekst i norsk lakse- og ørretoppdrett:**

Til politikerne på Stortinget

12.06.15

**Internasjonal bekymring for utviklingen av norske oppdrettsindustri, og dens negative effekter på villaksen**

Den nordatlantiske villaksvernorganisasjonen (NASCO) var samlet til sitt årlige møte 2.-5. juni i Canada, ved Lake Melville i Labrador. Partene i NASCO-konvensjonen er Norge, Canada, USA, Den europeiske union(EU), Russland og Danmark på vegne av Grønland og Færøyene. Formålet med

# Talk about the Salmon sucsess!

- The fight against G. salaris
- Liming make rivers grate again
- Gene-bank save vurnable stocks
- Spawnig target are reached
- Scientist with integrity
- Managers with knowledge
- River owners with respons
- Anglers with passion

**The Salmon is our Panda!**

NORSKE LAKSEELVER

# Proud river managers!

NORSKE LAKSEELVER

*- for mer liv i elva!*

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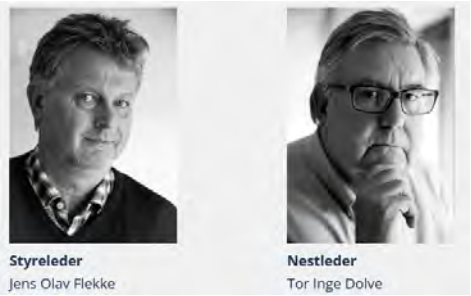
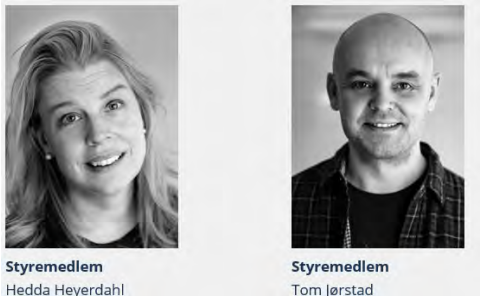
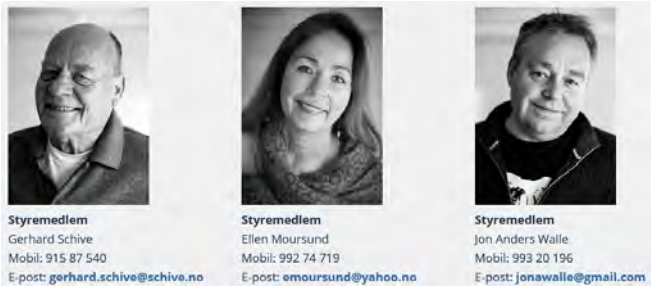
Stiftelsen Nordatlantisk Villaksfond Norge

# Reddvillaksen.no (NASF Norway)




- Voluntary work
- Most of our activities financed by Oslo Auction in November
- A few finance contributors.
- Charity is «absent in Norway»
- https://reddvillaksen.no/reddvillaksens-basic-facts-about-wild-salmon/
- https://www.facebook.com/reddvillaksen.no/

# Wild Salmon Alliance

Fish farmers

Authorities

Press

?

?

| | | | |
|---|---|---|---|
| njff.no | lakseelver.no | wwf.no | frifo.no |
| virke.no | skog.no | naturvernforbundet.no | greenpeace.no |
| bondelaget.no | reddvillaksen.no | sabima.no | nu.no |

*Alle organisasjoner i villaksalliansen 2016*

# We focus on the abudance of the wild salmon and seatrout that we all love.

# Any sympathy?

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Stiftelsen Nordatlantisk Villaksfond Norge

## 0,07 million people are fishing salmon, 5,3 million population

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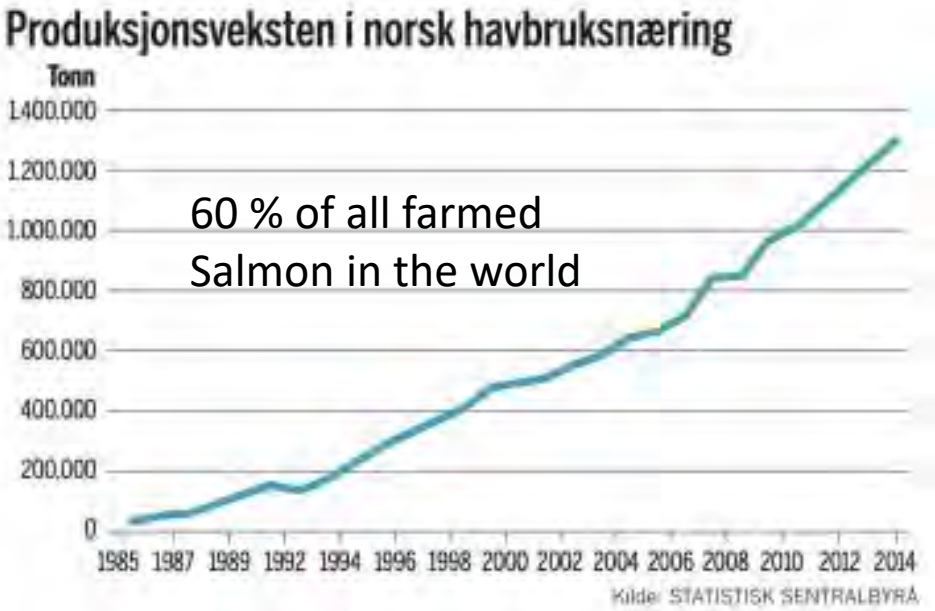
Stiftelsen Nordatlantisk Villaksfond Norge

# Wild versus farmed salmon

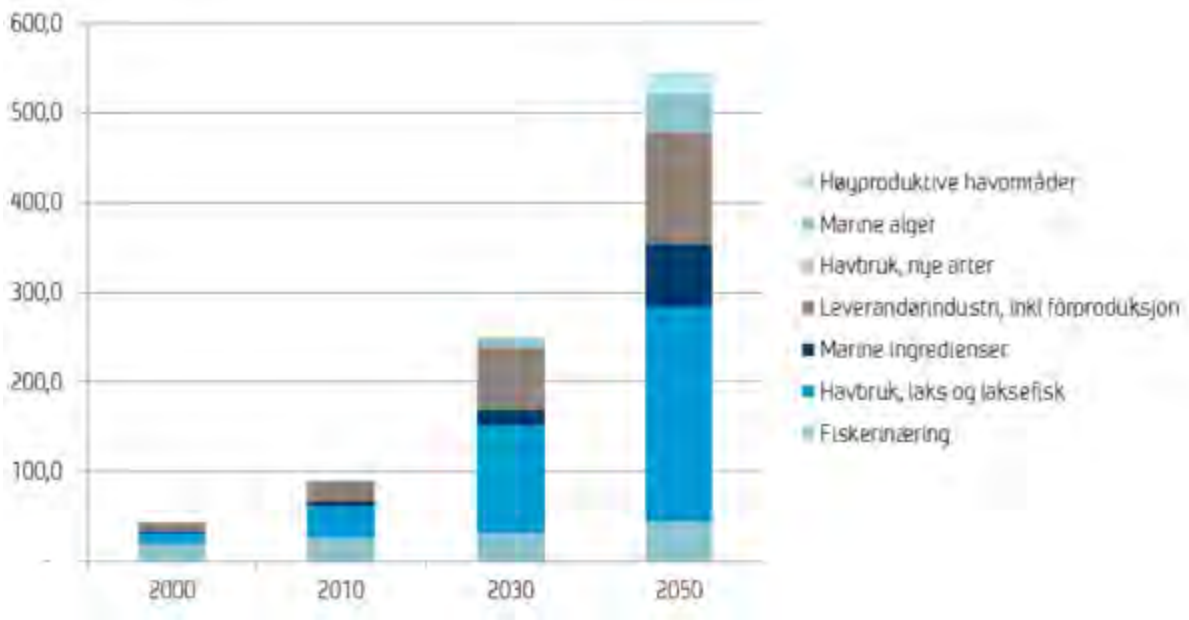
## WILD in number


## FARMED in tonnes




60 % of all farmed
Salmon in the world

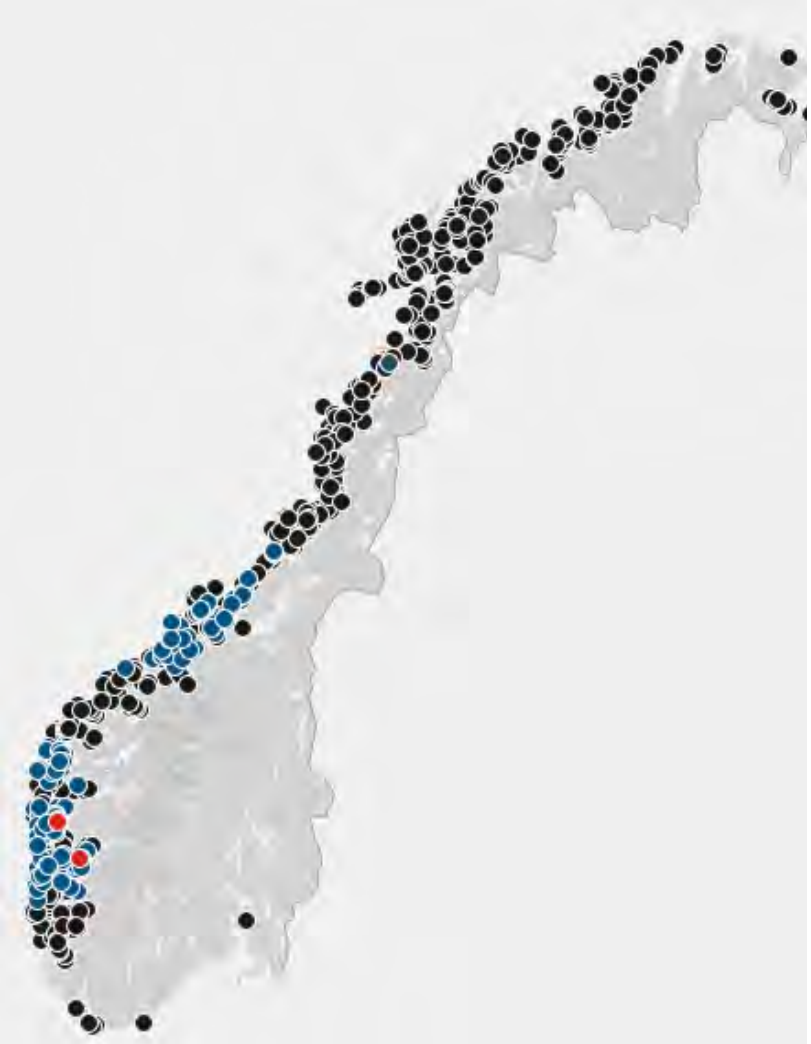
# Norwegian “official strategy” for growth in marine sector (Billion NOK)




- Basis: Project "future salmon farming." Technology Council recommends a new strategy 23/04/2012
- It was more like a “think tank”, but industry and politicians adopted it

# Locations in operation

- One unit = 400 x 3 concessions = 600 tons = Max 2200 tons.
- Through-put = 1,3 mill tons
- **4000 x Matorka**
- 100 % land-based is unrealistic
- Transparent info – but big data



# Awareness.

## Animal welfare? 53 million salmon died in 2017

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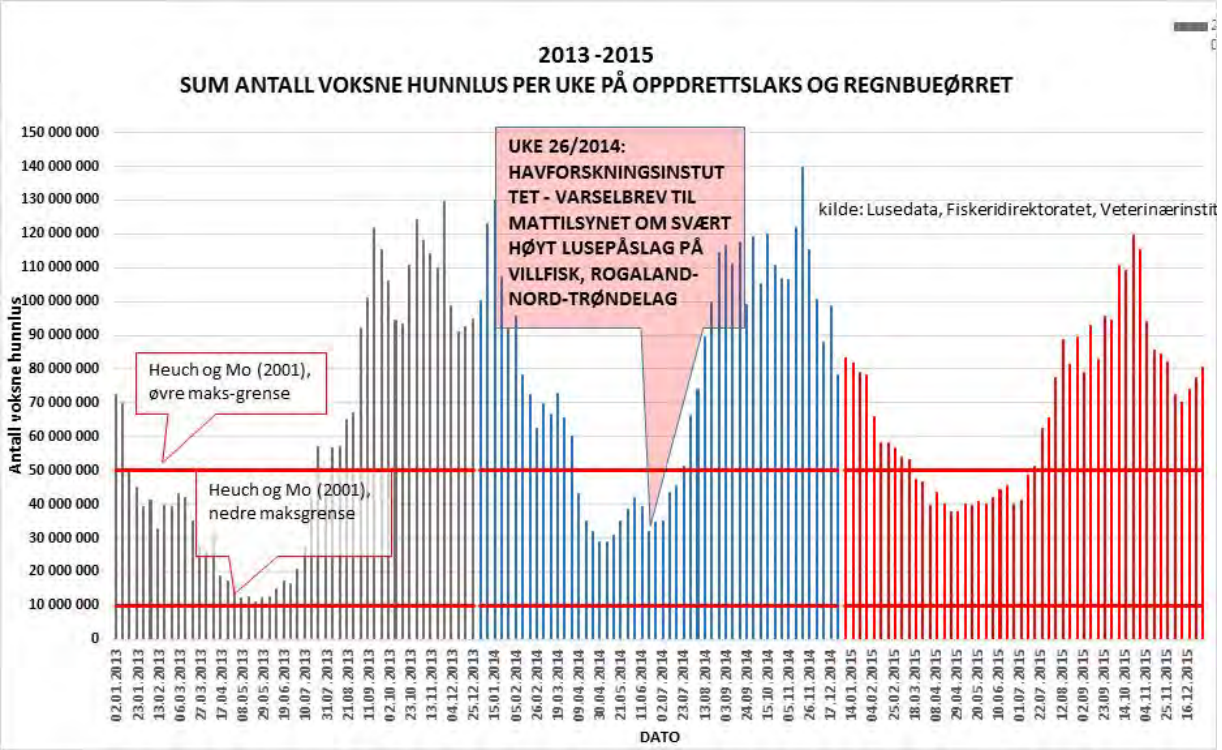
Stiftelsen Nordatlantisk Villaksfond Norge

# Information is available at production site level


[Visit Barentswatch]

# Chemicals

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Stiftelsen Nordatlantisk Villaksfond Norge

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| azametifos | | | 66 | 1884 | 3346 | 2437 | 4059 | 3037 | 4630 | 3904 |
| cypermetrin | 49 | 30 | 32 | 88 | 107 | 48 | 232 | 211 | 162 | 85 |
| deltametrin | 23 | 29 | 39 | 62 | 61 | 54 | 121 | 136 | 158 | 115 |
| diflubenzuron | - | - | - | 1413 | 1839 | 704 | 1611 | 3264 | 5016 | 5896 |
| emamektin | 60 | 73 | 81 | 41 | 22 | 105 | 36 | 51 | 172 | 259 |
| teflubenzuron | - | - | - | 2028 | 1080 | 26 | 751 | 1704 | 2 674 | 2509 |
| hydrogen-peroksid (100%) (tonn) | | | | 308 | 3071 | 3144 | 2538 | 8262 | 31577 | 43246 |

*Bruken av midler mot lakselus (kg aktiv substans). Kilde: Folkehelseinstituttet*

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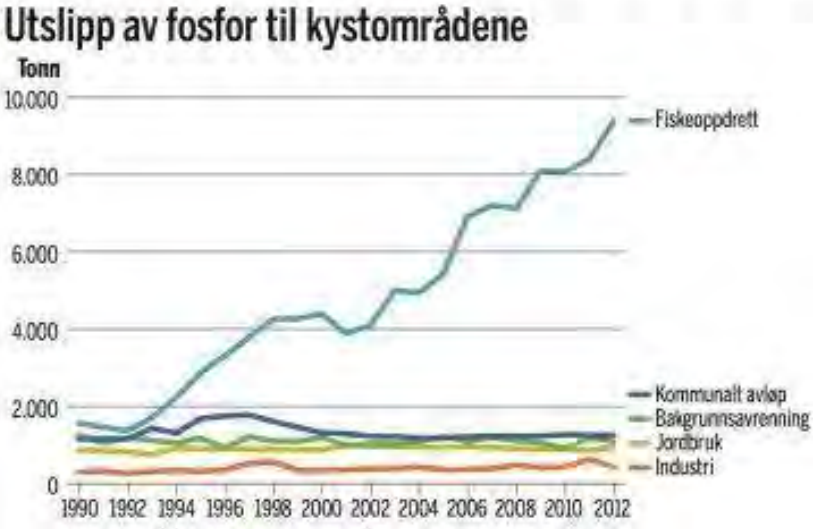
# Pollution (examples)


– Oppdrettsindus
grønn energi
rden

4- 500.000 TONNES OF «SEWER» PER YEAR
RIGHT INTO THE FJORDS. (18 MILLION PEOPLE)


**Kobber og hydrogenperoksid går ikke godt sammen**

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# WHEN THINGS GOES REALLY WRONG!

Kola Peninsula disaster 2015

8 mill. dead salmon left behind with all kinds of diseases. Sick fish entered many rivers.


-Better cooperation to save the salmon instead of competing to do the same.

-We must all concentrate to fill the big empty wading shoes that Orri left behind.

-To me, this day is a perfect start.