
HIDDENFJORD
RAISED IN THE WILD

Fish welfare to prevent sea lice issues

Esbern Jóannes Patursson

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Owners and management

Philosophy Hiddenfjord

Values

- Sustainability
- To be open and honest
- Innovation
- Financial prudence

Goals

- “To do ours so the farming in the Faroe Islands can thrive and reach it’s full potential”
- To produce the world’s best salmon
- To be a good workplace

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Employees

Fish welfare demands good leadership and meticoulus employees from roe to slaughter
Sufficient number of employees

Development team
Have time to concentrate and focus on ideas

Very short time from idea to action

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Exposed farming

- Started farming at Skálafjørðinum in 1984
- Moved to exposed farming at Gøtuvík in 1988
- Continuing the same direction

- Less impact on sediments
- Fewer sea lice
- Fewer algae
- Healthier fish
- Better fish welfare

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Sea lice population dynamics

Has been the main driver for exposed farming, and “all” other developments, since Gøtuvík 1988
- together with sediments

From onions to lasers..

An index of sustainability

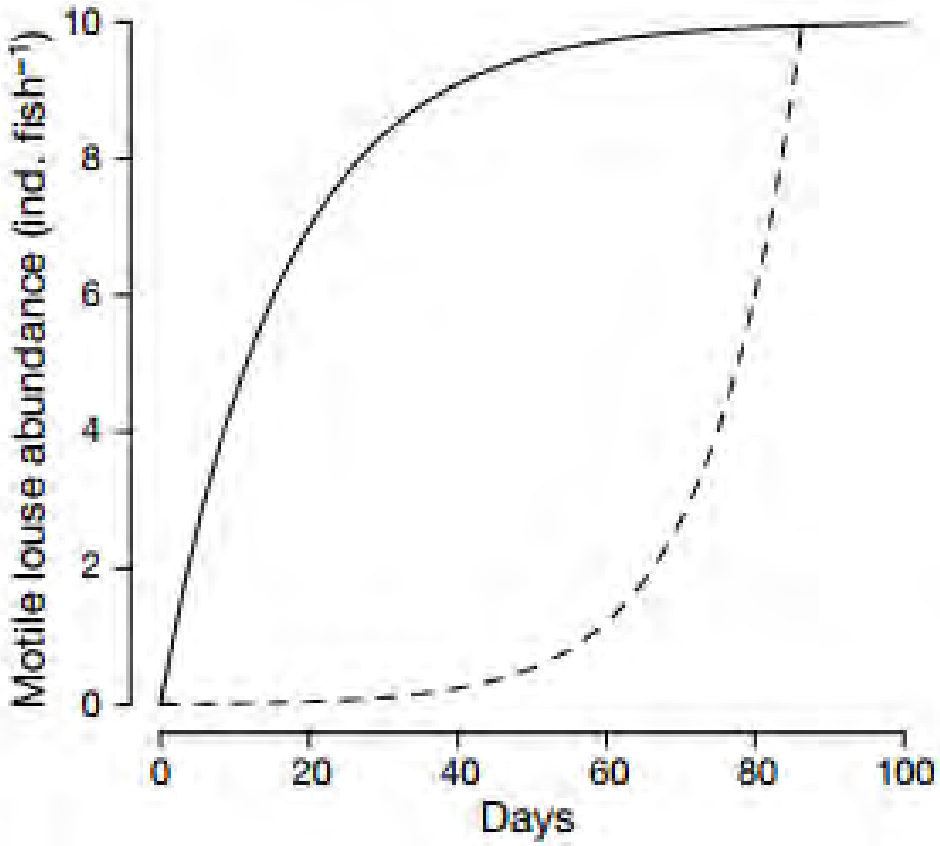
Fish welfare – quality – **Stress free harvest**

Control sea lice ~ control sustainabilty

Self-infection vs external infection

Exposed farming -> external infection

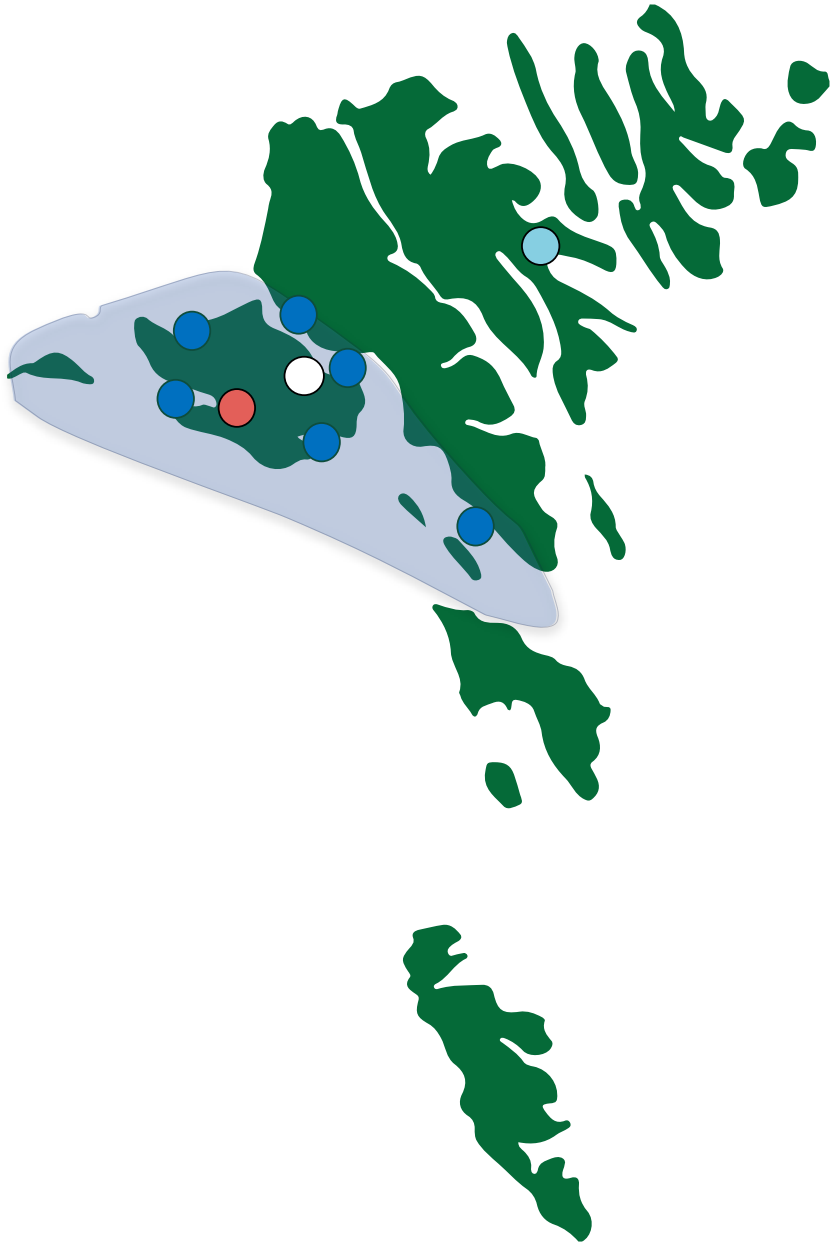
Strategic deployment



Self-infection (dashed line) external infection (line) (Krkosek *et.al.* 2010)

Hiddenfjord

- **Hatchery**
- **Seafarming**
- **Production facility**
- **Administration**



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Exposed farming

Norwegian-Standard <- **3 m** = High exposure

Wave height (Hm050 (Hs) m)

Víkar: **9**

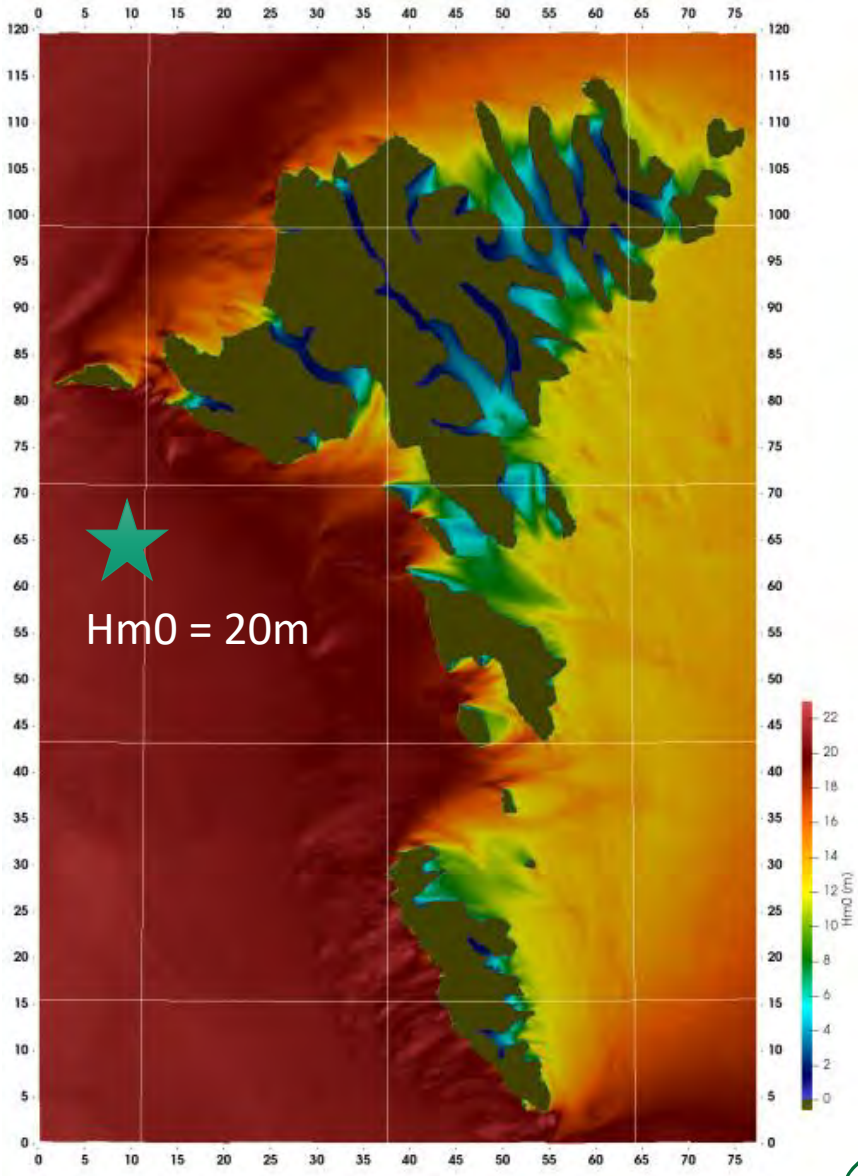
Sørvágur: **6**

Miðvágur: **6**

Velbastað: **6**

Vestmanna: 1-2

Suðuri í bug: 2-3



Niclassen and Simonsen, 2011

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Exposed farming

Current (cm/second)

Suðuri í buð:220 (start spring 2022)

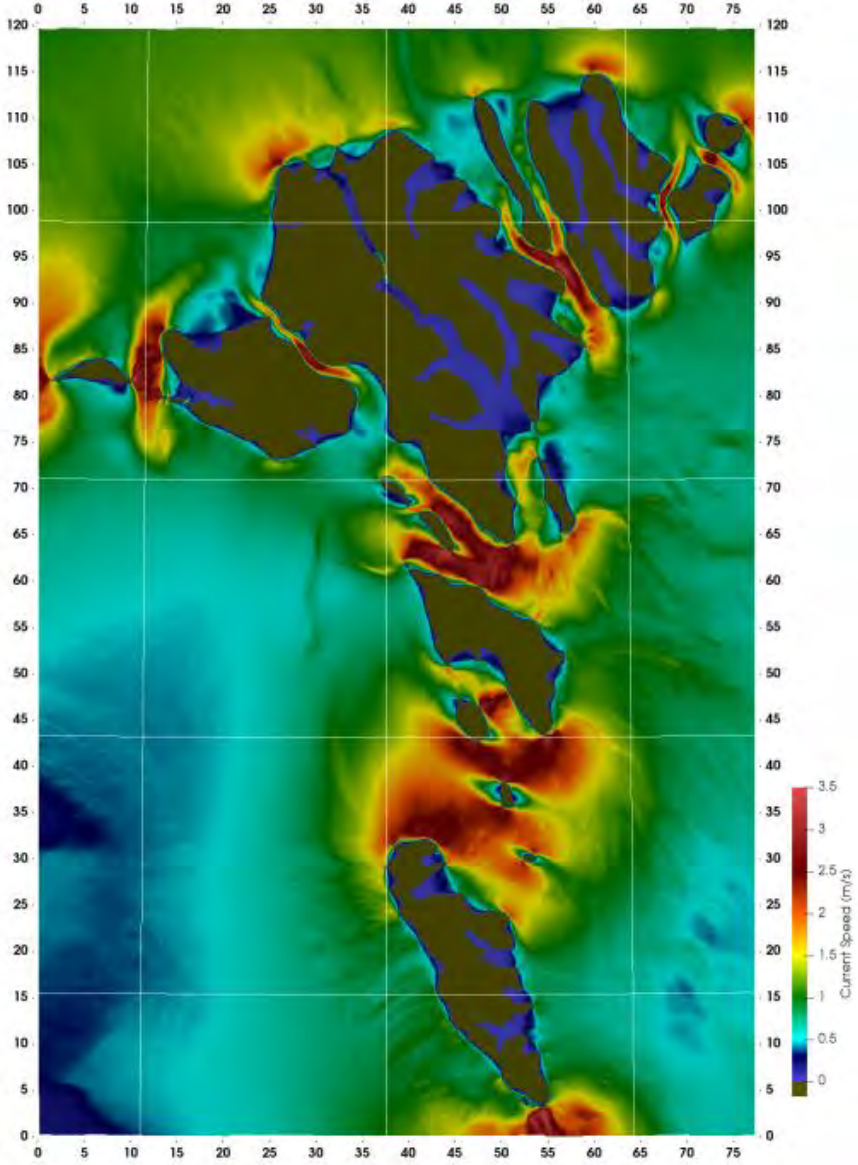
Vestmanna: 110

Velbastað:70

Sørvágur:50

Miðvágur:30

Víkar: < 50



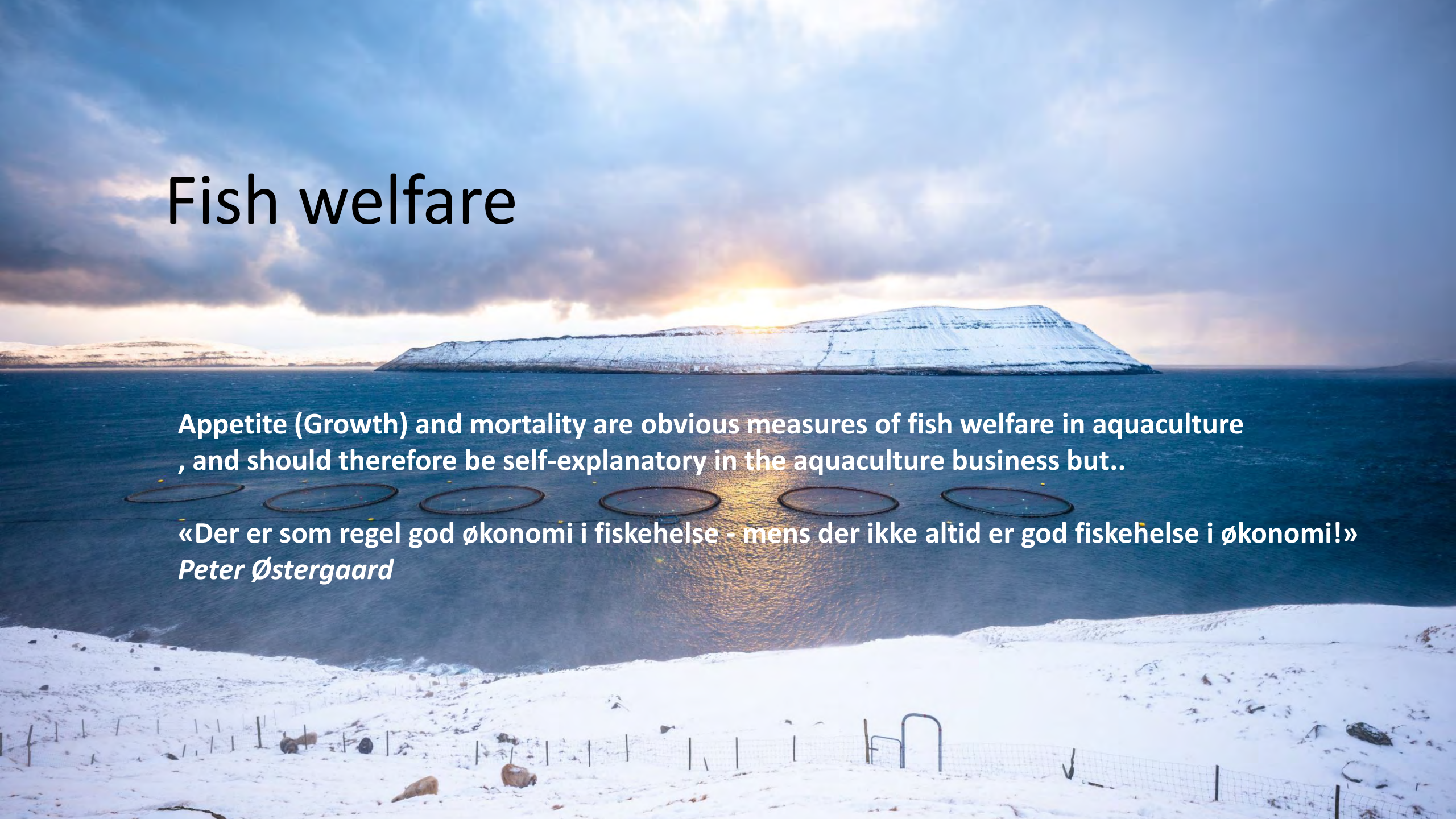
Niclassen and Simonsen, 2011

Worlds most exposed farming sites

…central questions regarding offshore aquaculture… To our knowledge, there are presently only two available studies on this topic, where both were conducted at wave-exposed sites on the Faroe Islands (Dam 2015; Johannesen et al. 2020).

*Hvas etal. 2019. aquaculture.

Fish welfare

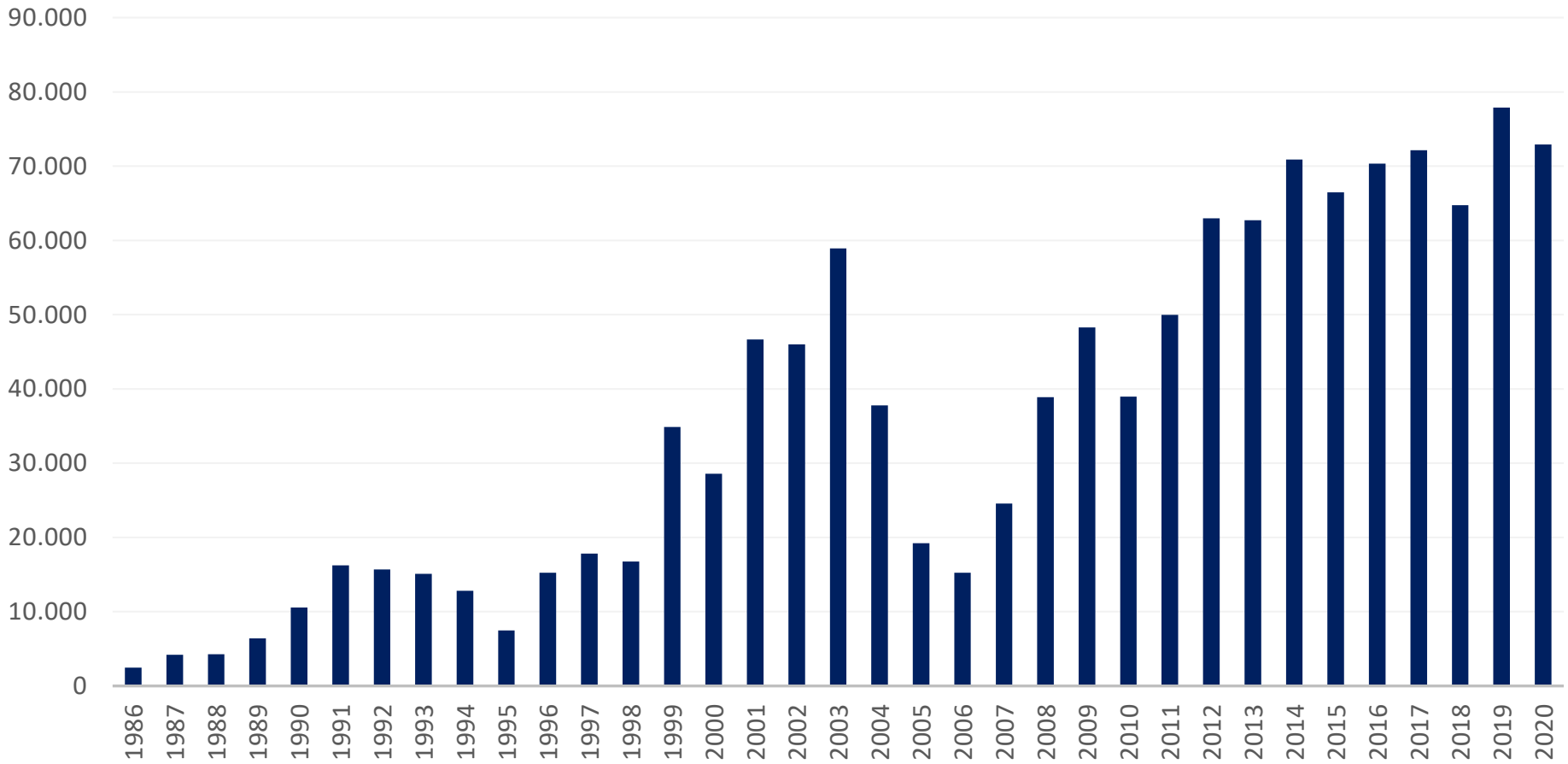


Appetite (Growth) and mortality are obvious measures of fish welfare in aquaculture , and should therefore be self-explanatory in the aquaculture business but..

«Der er som regel god økonomi i fiskehelse - mens der ikke altid er god fiskehelse i økonomi!»
Peter Østergaard

Production Faroe islands (tons gutted weight)

Fish welfare and apropriately strict regulations important



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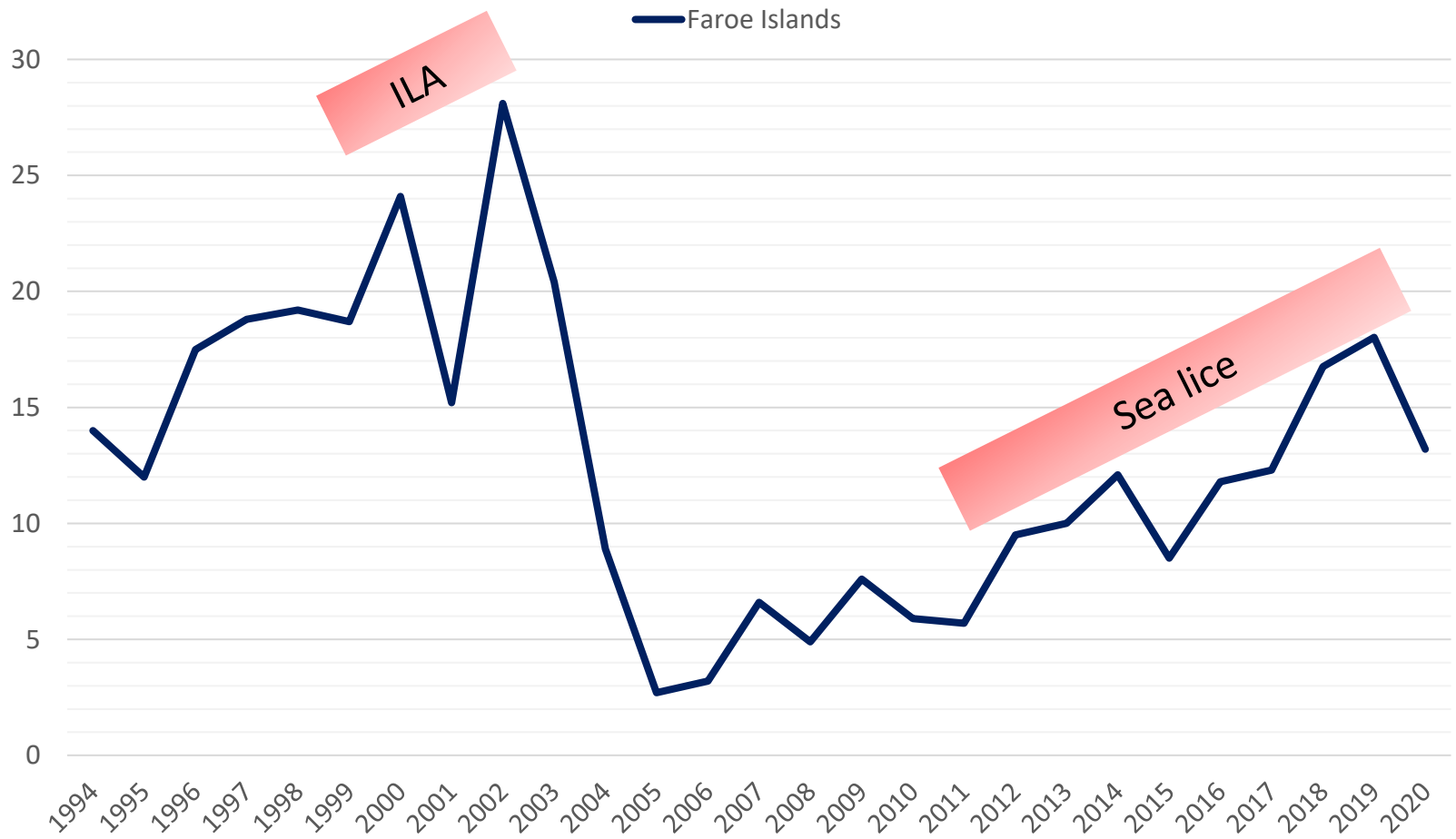
Yearly mortality

% of stocked salmon from stocking to harvest – pens harvested in given year.



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Sea lice strategy

Sea lice strategy Hiddenfjord

Exposed farming and a preventive approach

- Short time on sea
  - Large smolts -> good quality
  - Fast growth
- Lumpfish
- Strategical deployment

  Fewer salmon on problematic sites

- Planning and research

  Know the hydrodynamics and the population dynamics of sea lice of the farming sites
- Sea lice modelling
- Appropriately strict regulations
- If necessary – chemical treatment

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Main goals in combatting sea lice - Change

2016

Preventation

1. No chemicals
2. No handling

2018

Preventation

1. No handling
2. No chemicals

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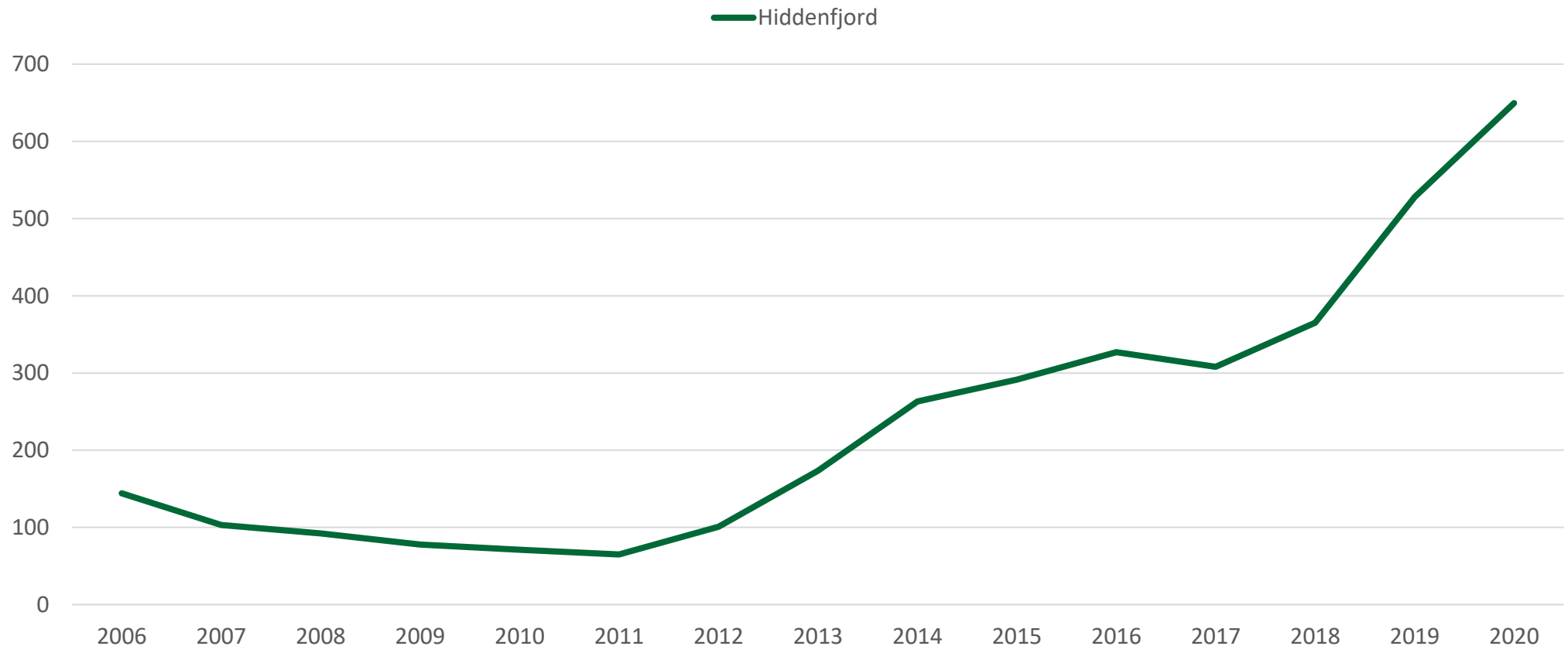
Short time on sea

Large smolts

Smolt weight

From year of harvest (not stocking)



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Fútaklettur 2000

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Fútaklettur 2019

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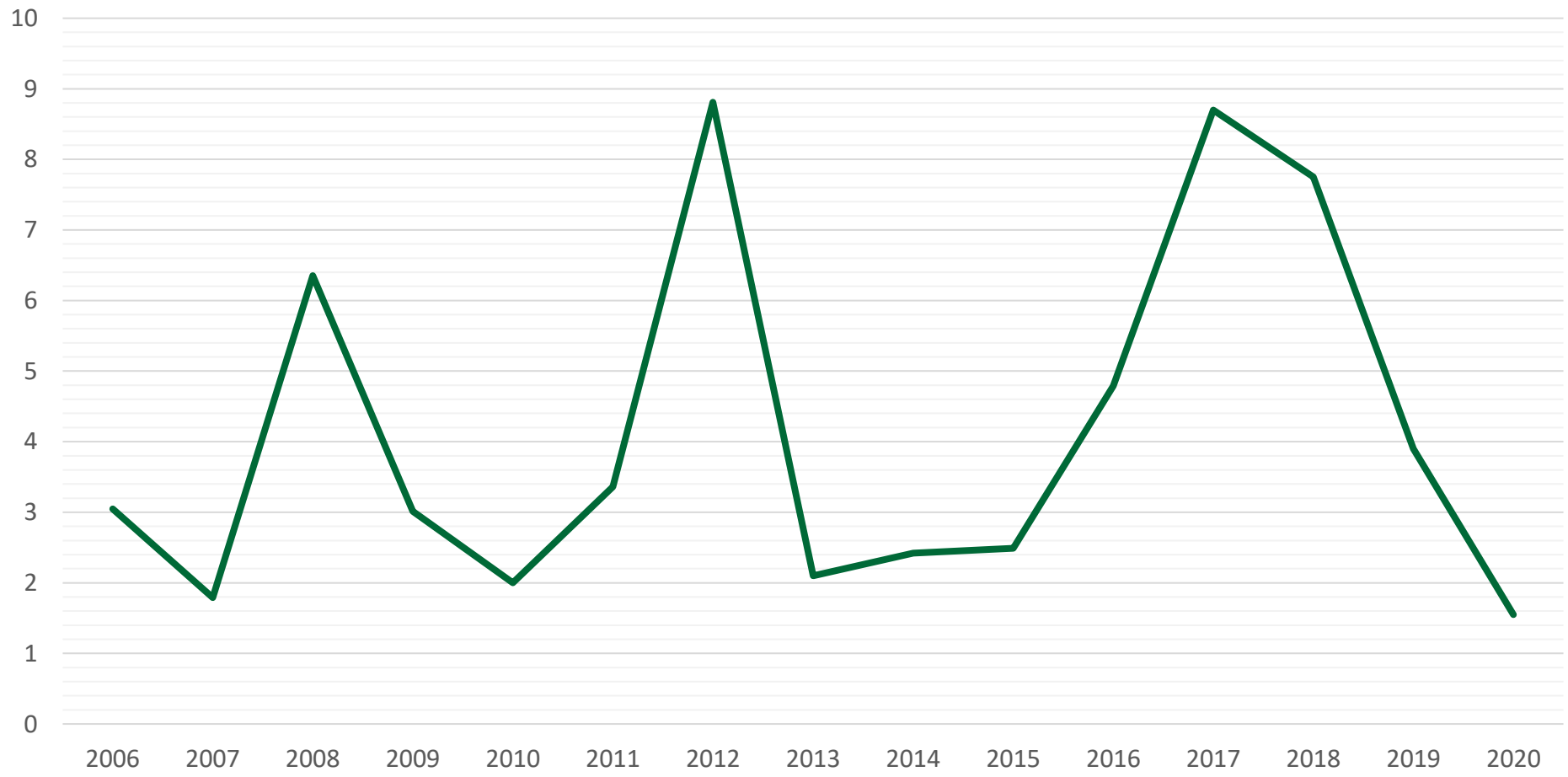
Smoltquality

- Low mortality
- Good growth potential
- Start feeding right after stocking

Stocking mortality %

Mortality the first 3 months on sea



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Respirometry

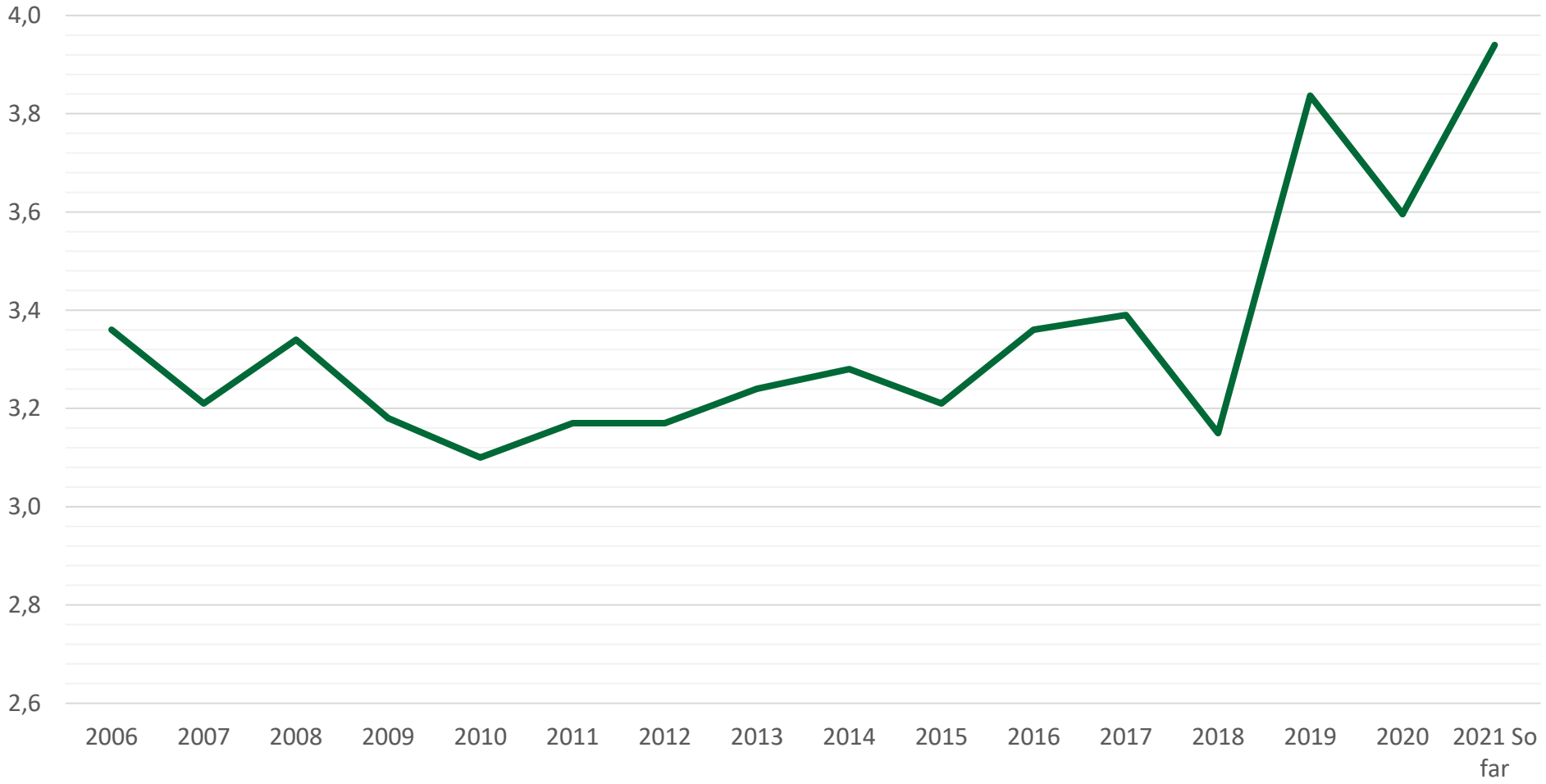
Heðrikur Bergsson

Important with exposed farming

A better start (Short time on sea)

Growth

Growth (TGC (VF3))



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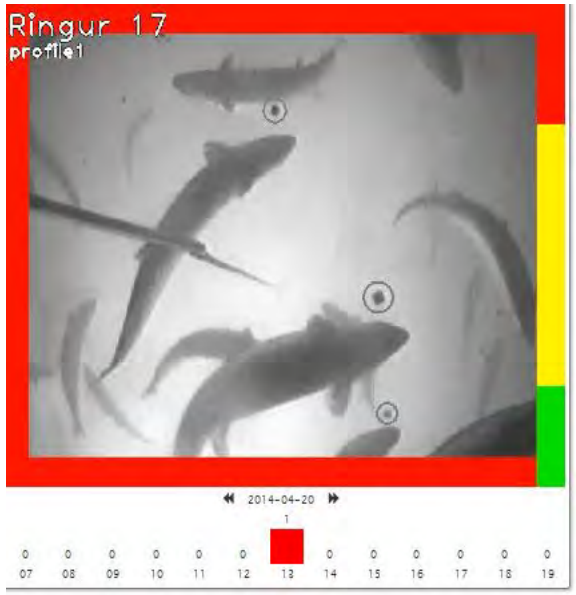
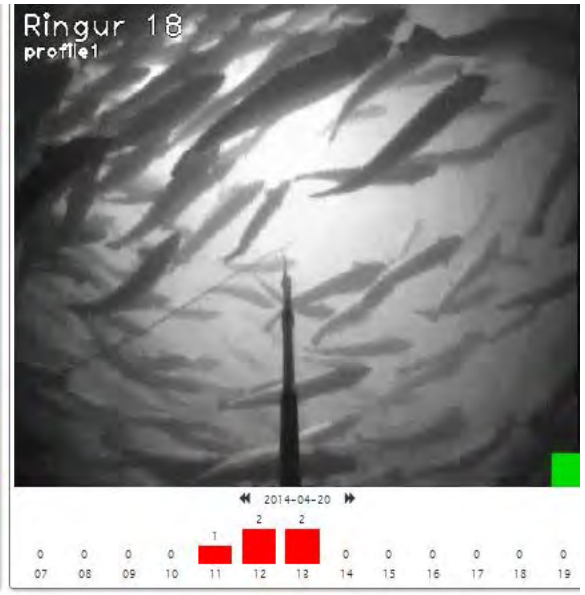
Effort in feeding

Pellet detector and automated feeding from FaroeSea





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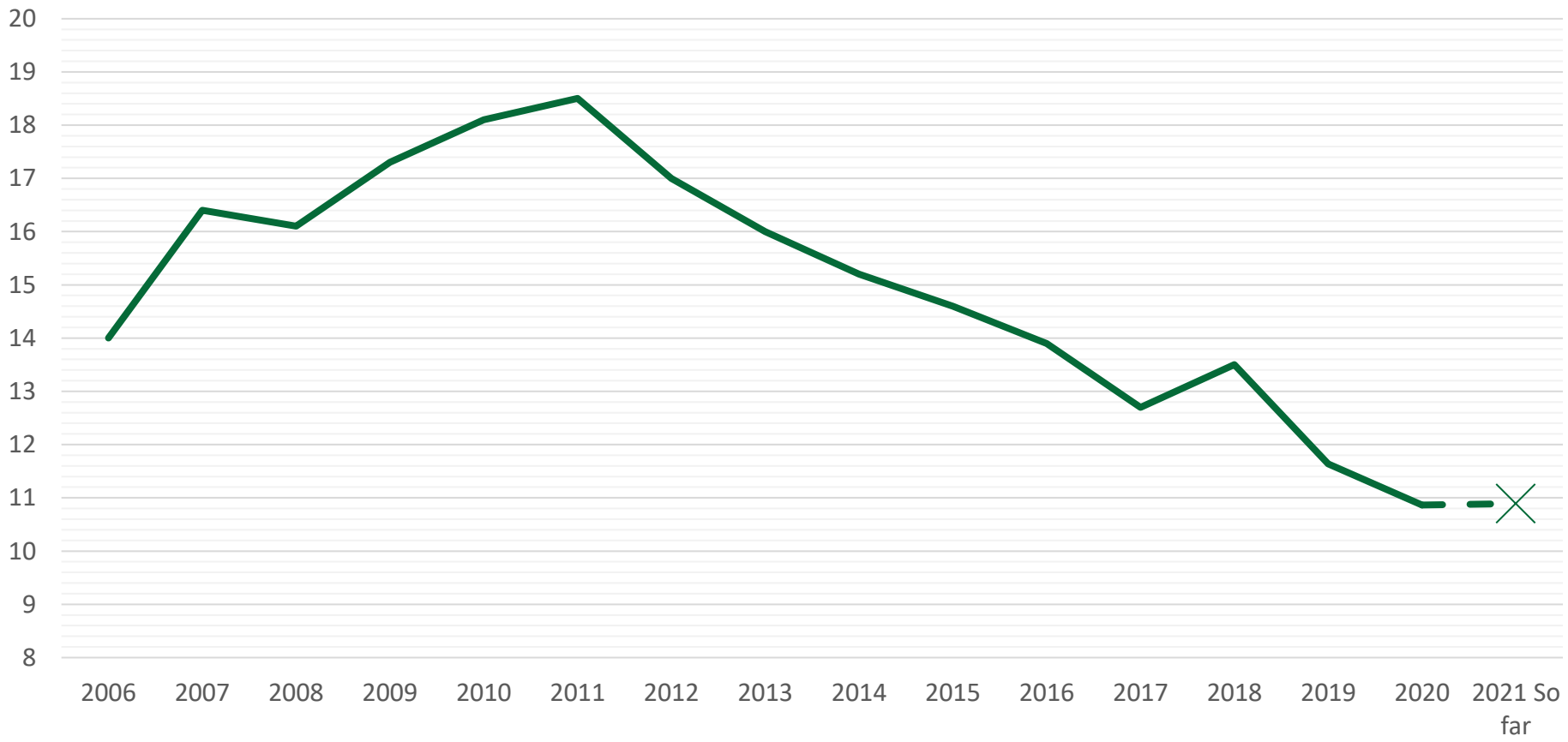
Months on sea



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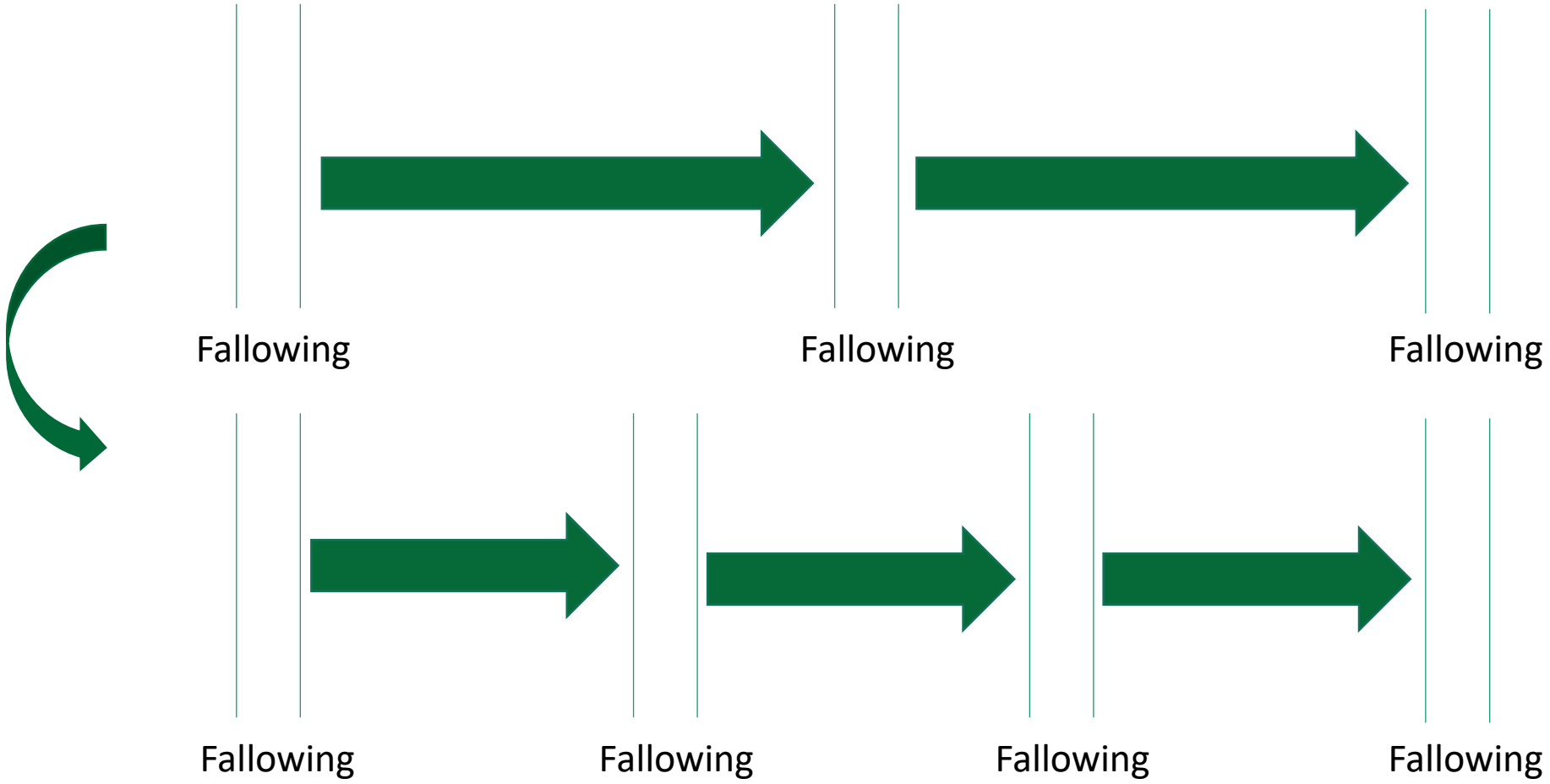
Farming cycles at Sea

Reduces biological risk -> fewer sea lice -> improved welfare



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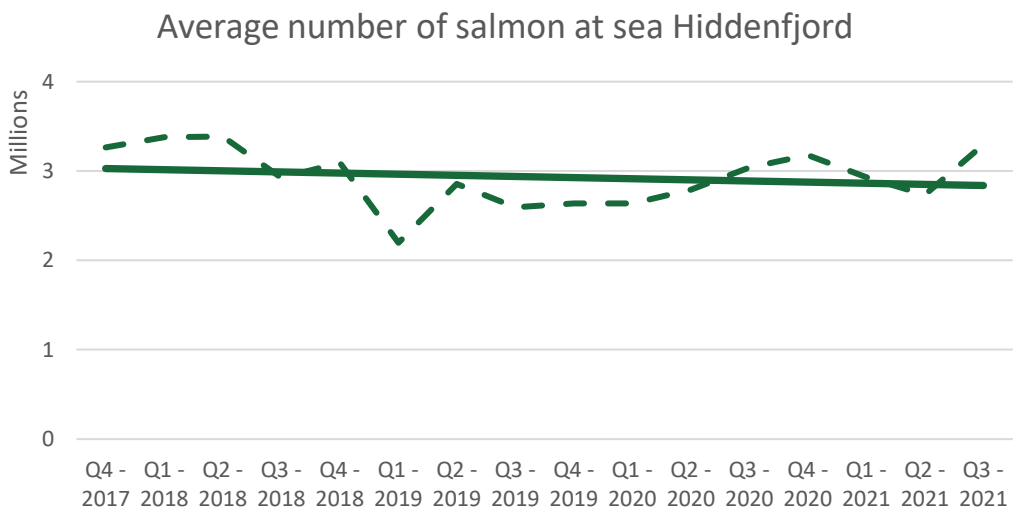
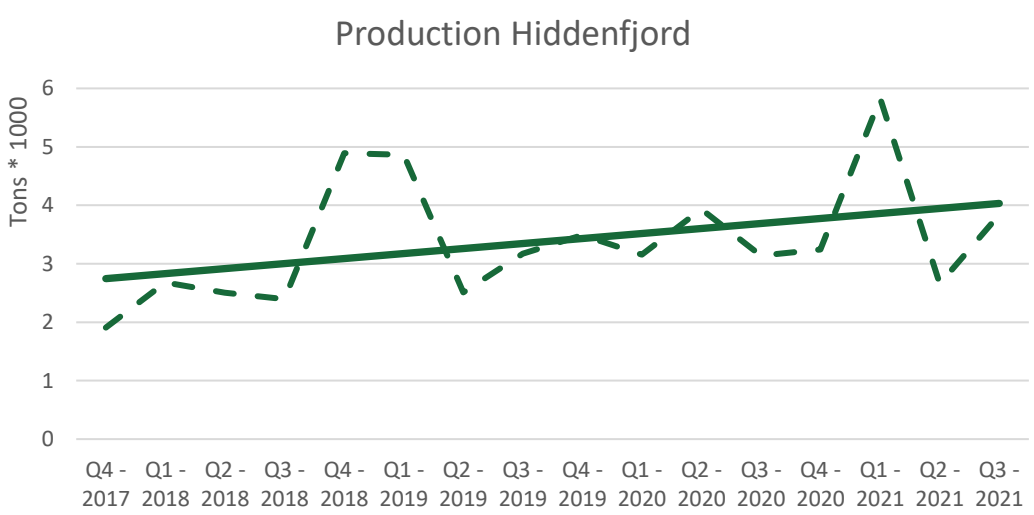
Sustainable farming

~ 7 % decrease



~ 43 % increase



Large smolts with fewer/equal number of salmon

- Increased production
- Fewer sea lice
- Less handling of the salmon
- Lower biological risk

- Higher intensity -> Increased pressure on sediment
  - Solution -> Exposed farming – resuspension of sediment
    - Less internal infection pressure – easier to manage sea lice

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Lumpfish

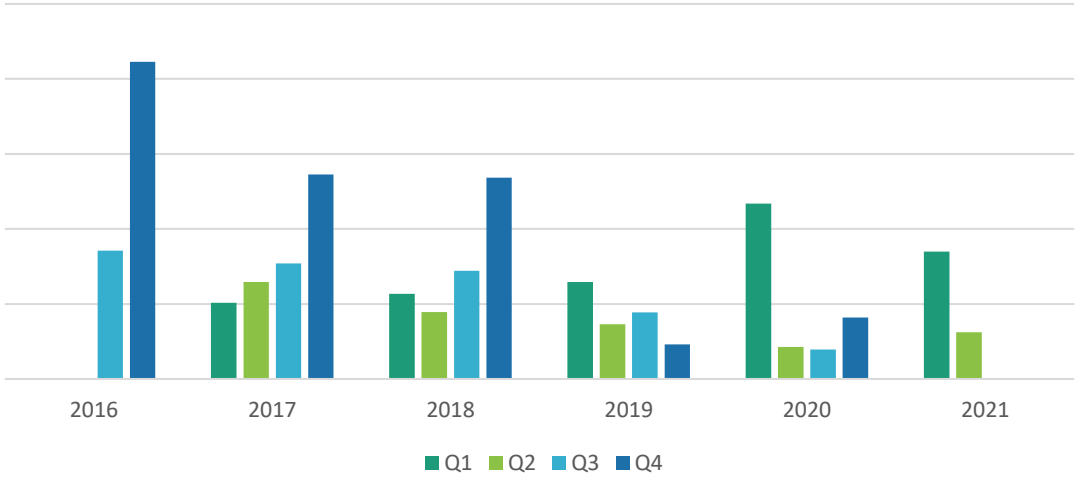
Good for salmon welfare – Lumpfish welfare has to improve

Lumpfish

Very effective sea lice grazers
Crucial in for our strategy
Mortality steadily decreasing

% lumpfish grazing on sea lice

Lumpfish mortality



- New vaccines
  - P. anguillisceptica
  - Pasterurella sp.
    - Tenacibalum next
- Research
- Strategy
- Feeding
- Hides

We have resonable hope that mortality and wellbeing of lumpfish will come to a satisfactory level

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Planning and research
Hydrodynamic meaurements
Strategical deployment

Sørvágur

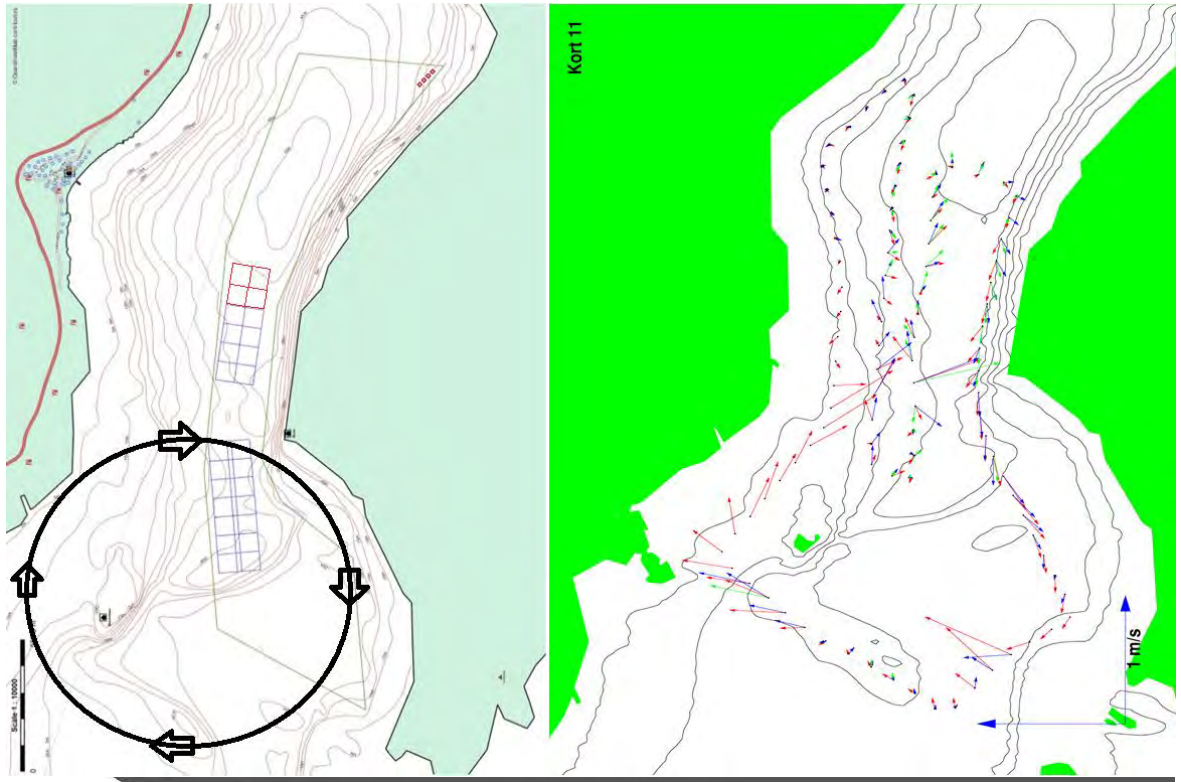
Our most problematic site

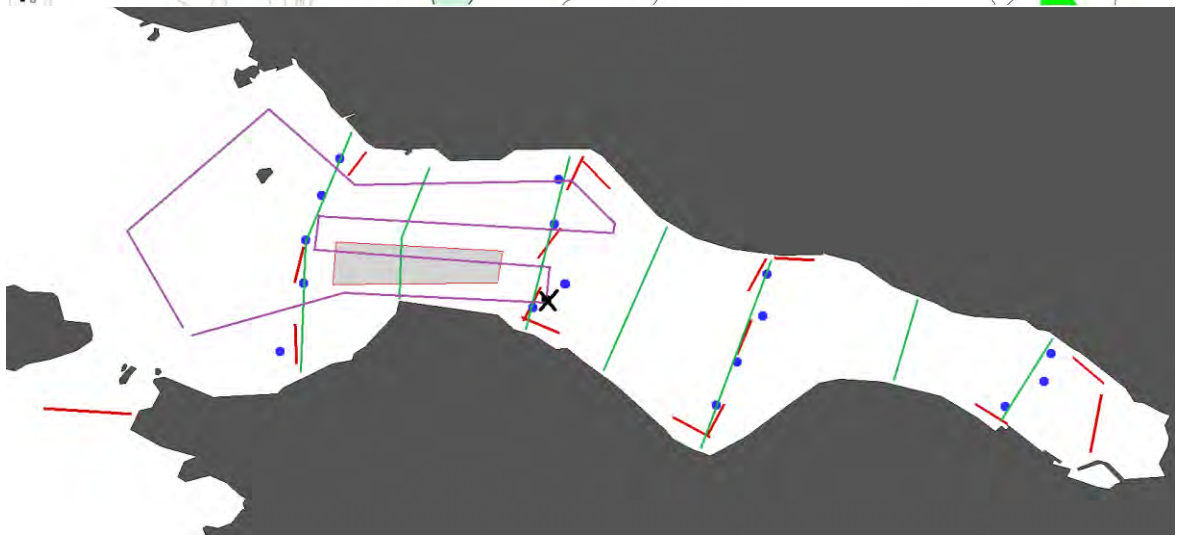
- Hydrodynamic measurements

- Sea lice tawls

- Strategic deployment – salmon count

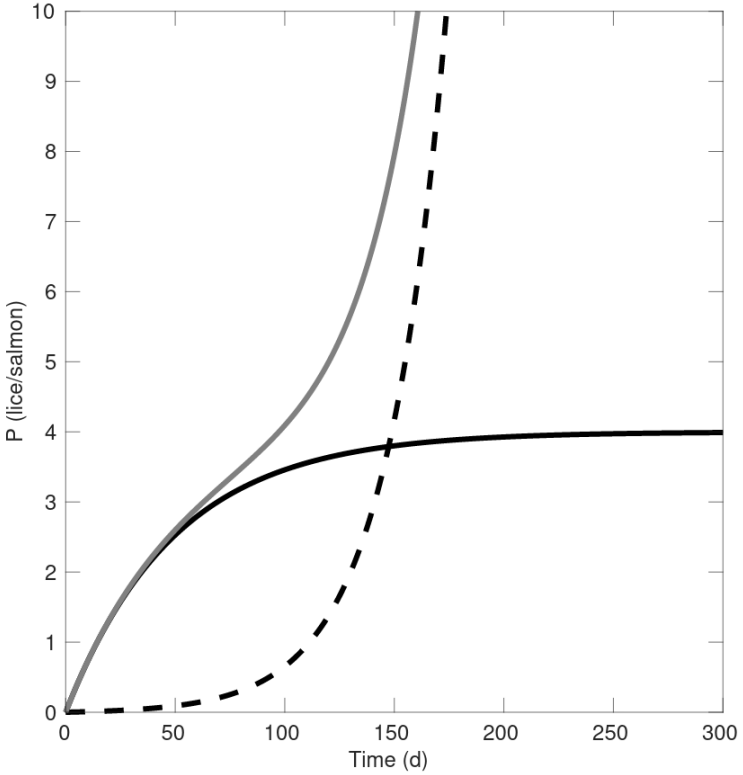
- Self infection vs external infection



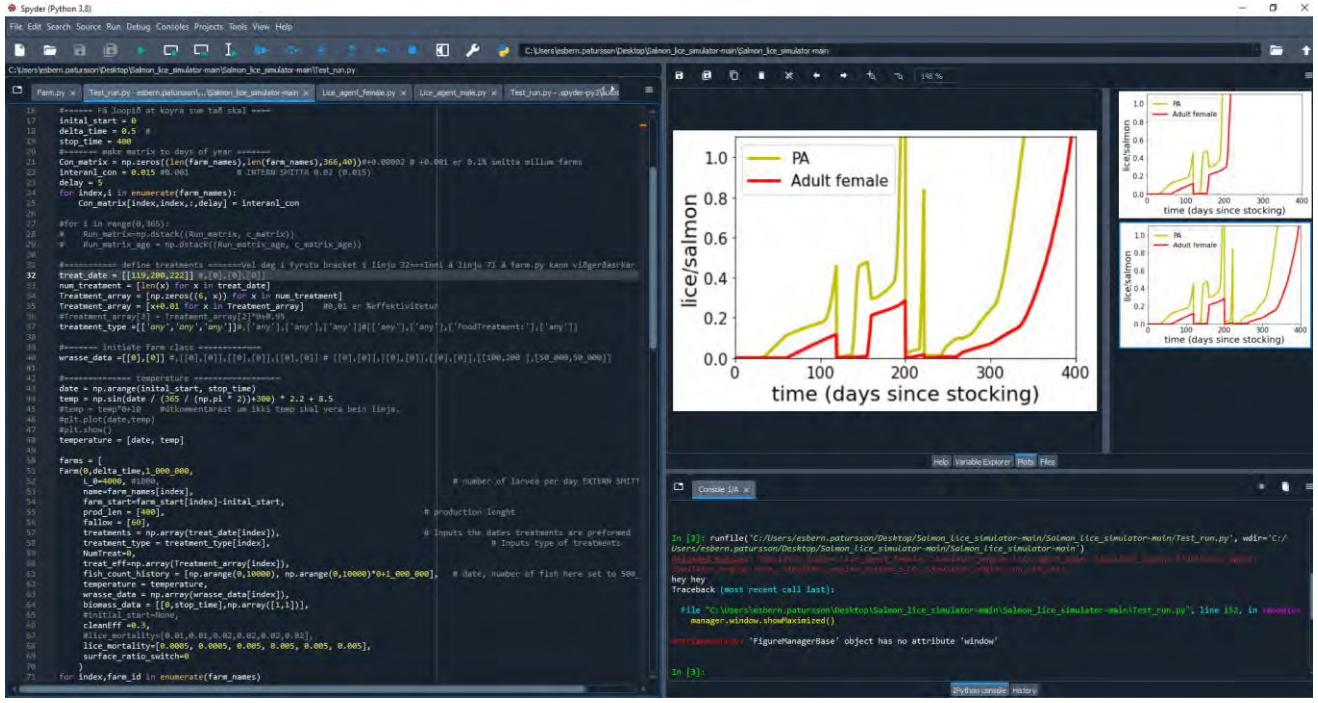


Sea lice modelling

Internal infection pressure (dashed line) and external infection pressure (line) (Kragesteen, *2019*)

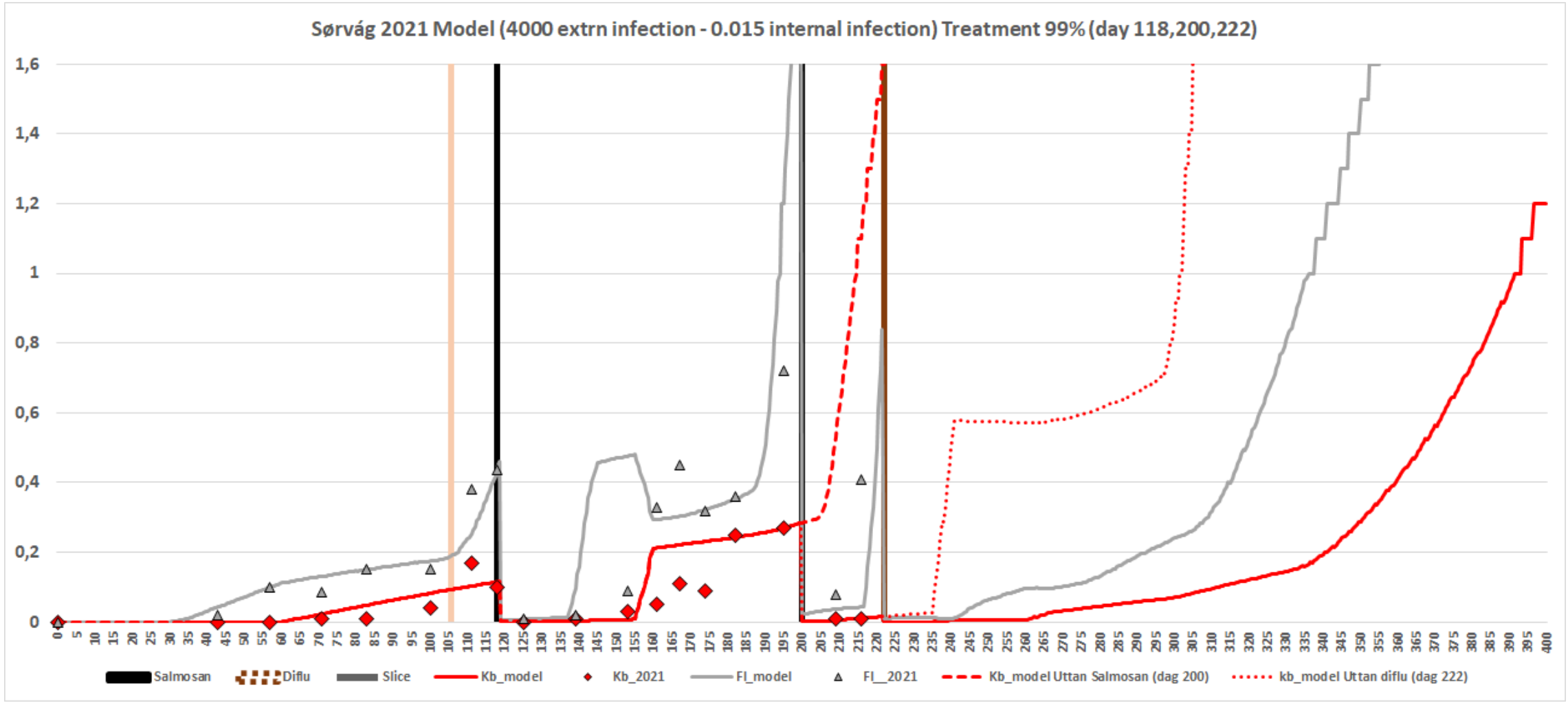


Agend based salmon lice model, tracking development of all sea lice stages, depending on temperature.
https://github.com/TrondurJK/Salmon_lice_simulator



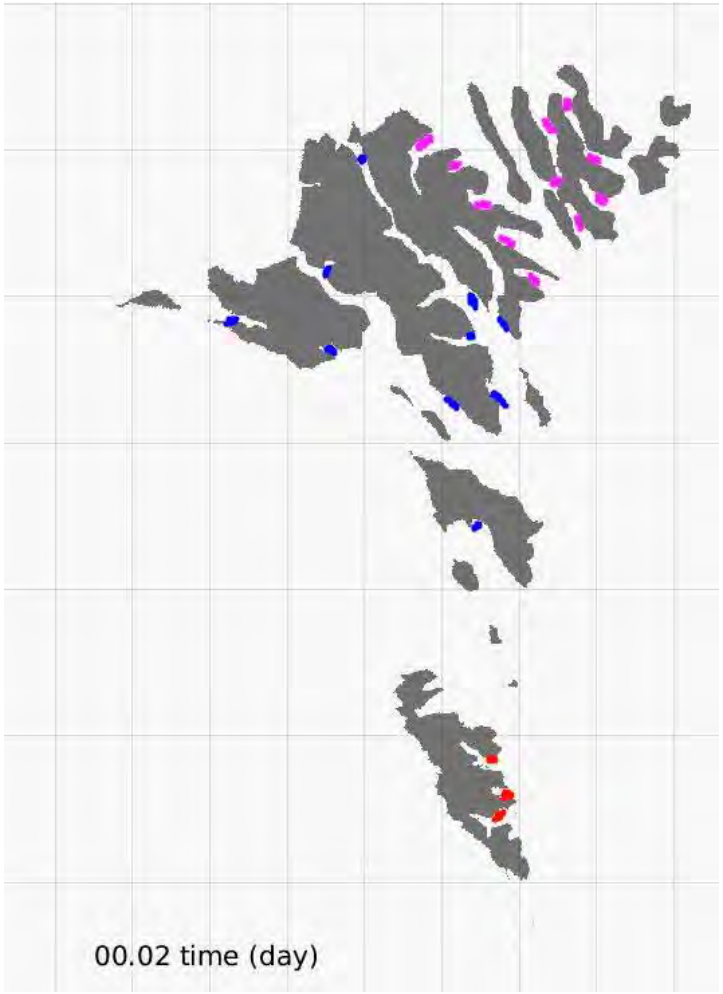
Sea lice modelling

A crucial tool for internally infected sites




The need for appropriately strict regulations

Sea lice are a common enemy



- Can travel all the way around the Faroes in the infective stage
- Needs strict regulations to avoid tragedy of the commons

Particle simulation of sealice (Kraagesten *et.al.* 2018)

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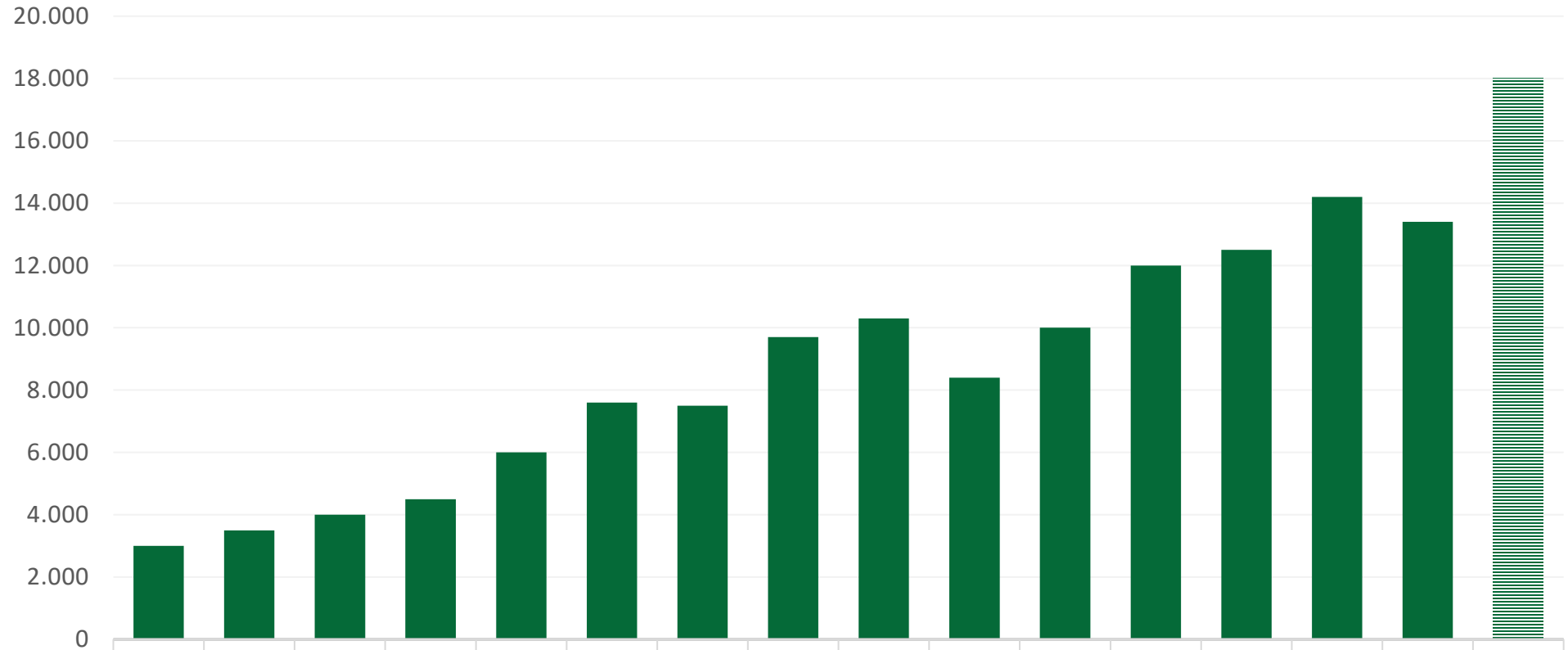
How is it going?

Production Hiddenfjord

(Mt gutted weight)



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
HF	3.000	3.500	4.000	4.500	6.000	7.600	7.500	9.700	10.300	8.400	10.000	12.000	12.500	14.200	13.400	18.000

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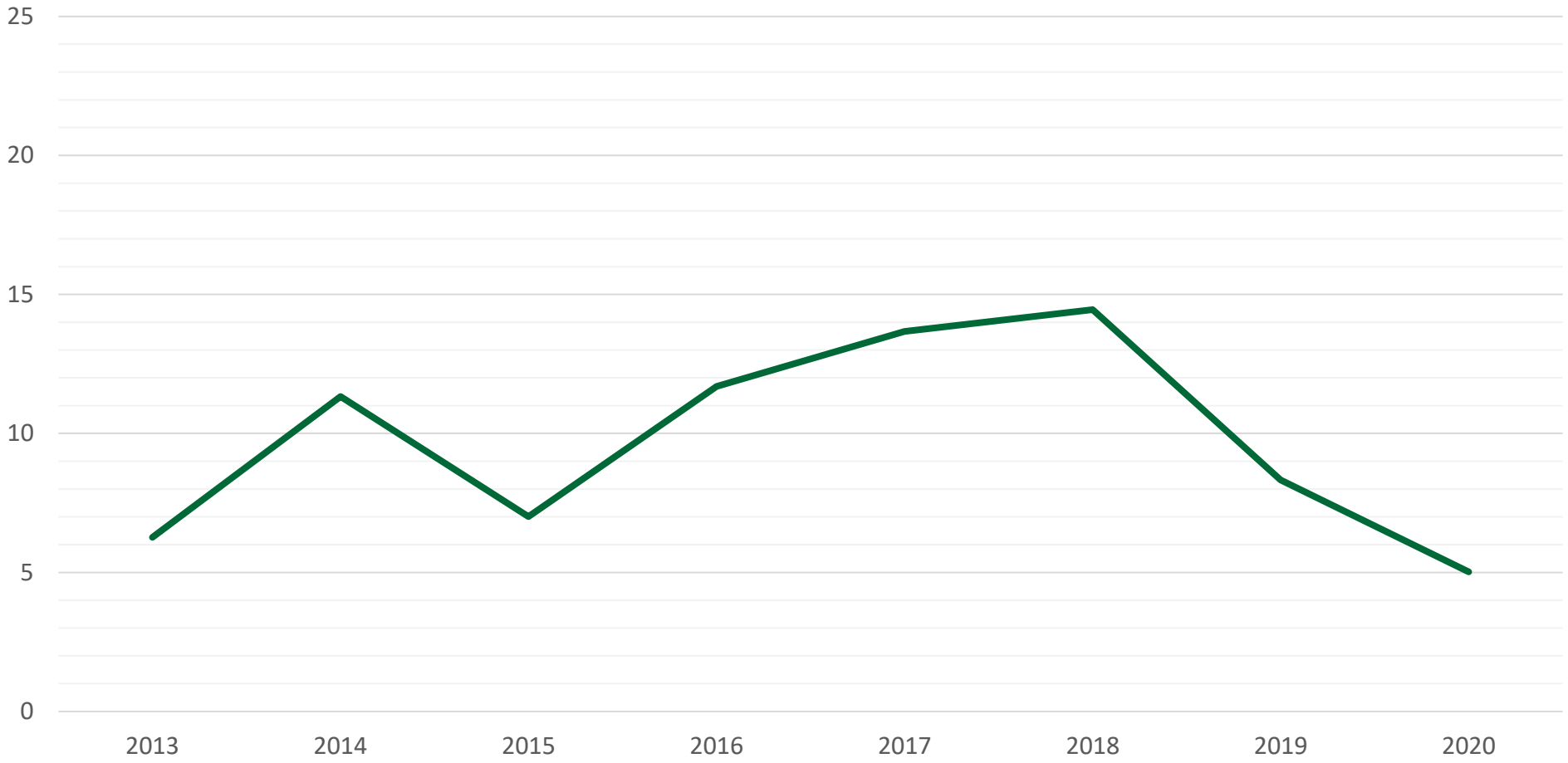
Yearly mortality

% of stocked salmon from stocking to harvest – pens harvested in given year.



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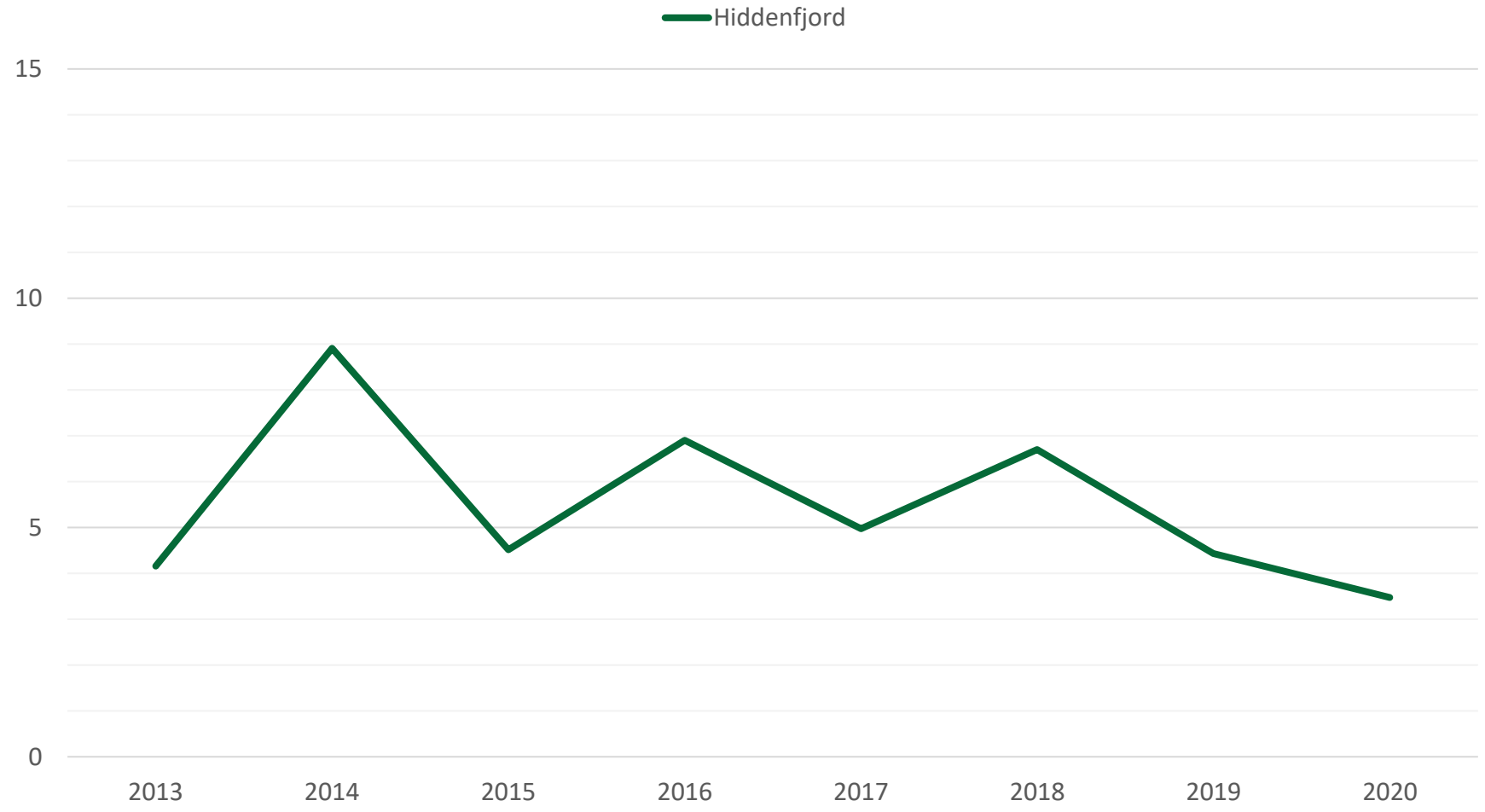
Mortality % of large salmon

Mortality the first 3 months on sea not included.



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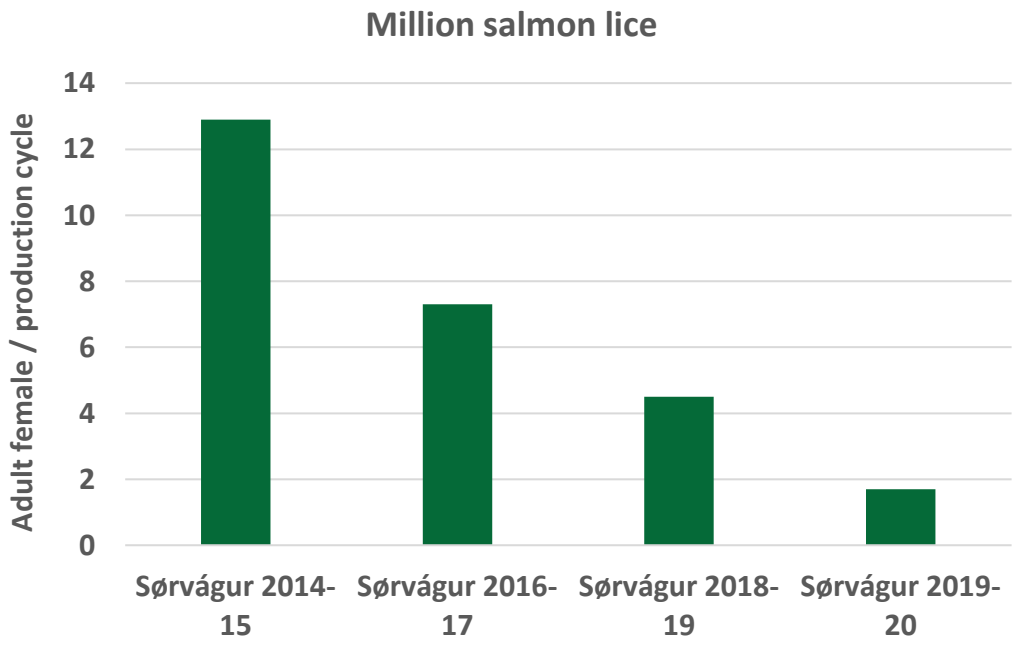
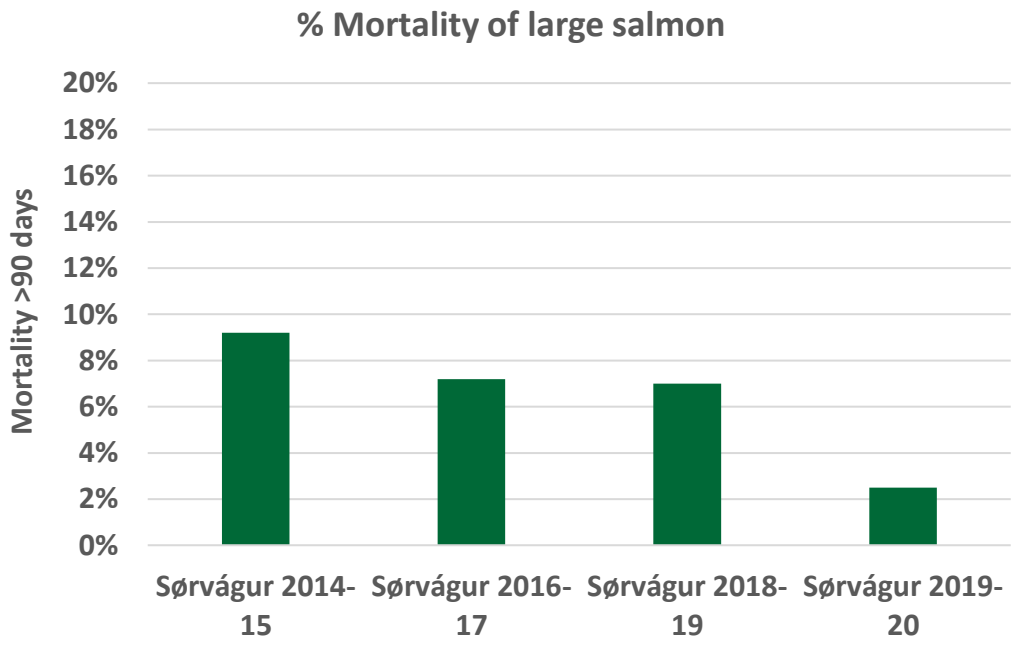
Sea lice strategy - Results

Sørvágur





						Deloused pens					
Production cycle	**Stocked salmon**	**Sea lice**	**Weight**	**Mortality >90dg**	**Days on sea**	**Slice**	**Salmosan**	**Diflu**	**Combi**	**Mechanic**	**Total**
Sørvágur 2014-15	**1.0 mill**	**12.9 mill**	5,6 kg	**9,2%**	**438**	14			31	14	**59**
Sørvágur 2016-17	**1.1 mill**	**7.3 mill**	5,0 kg	**7,2%**	**385**	11			1	45	**57**
Sørvágur 2018-19	**1.2 mill**	**4.5 mill**	6,7 kg	**7,0%**	**381**	10	19	5	13	15	**62**
Sørvágur 2019-20	**0.9 mill**	**1.7 mill**	5,3 kg	**2,5%**	**333**	12	15	8			**35**

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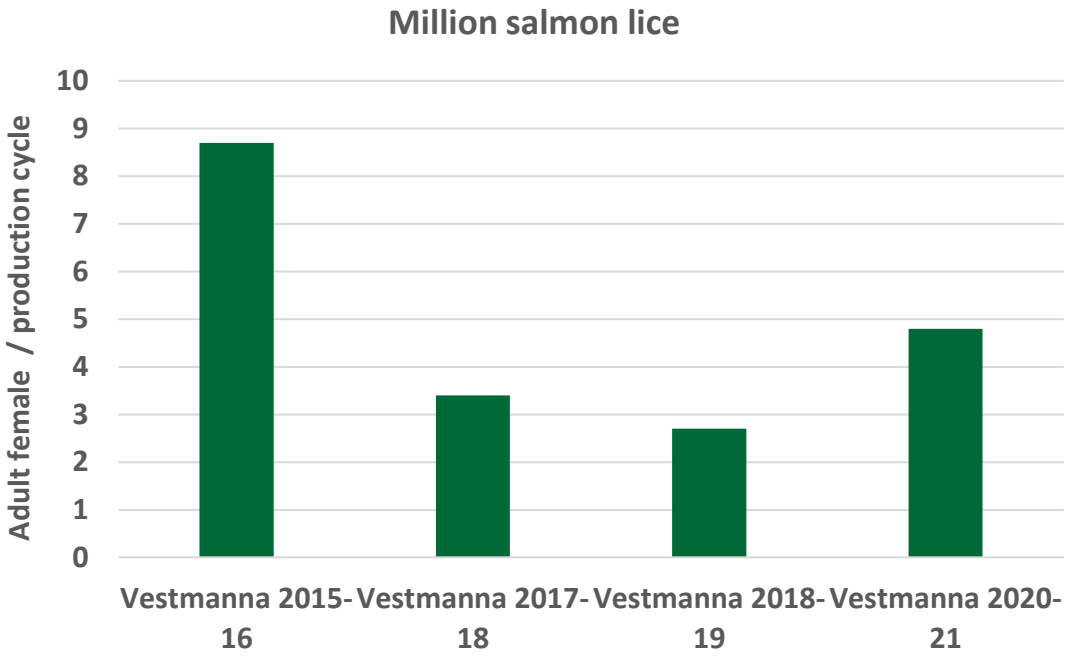
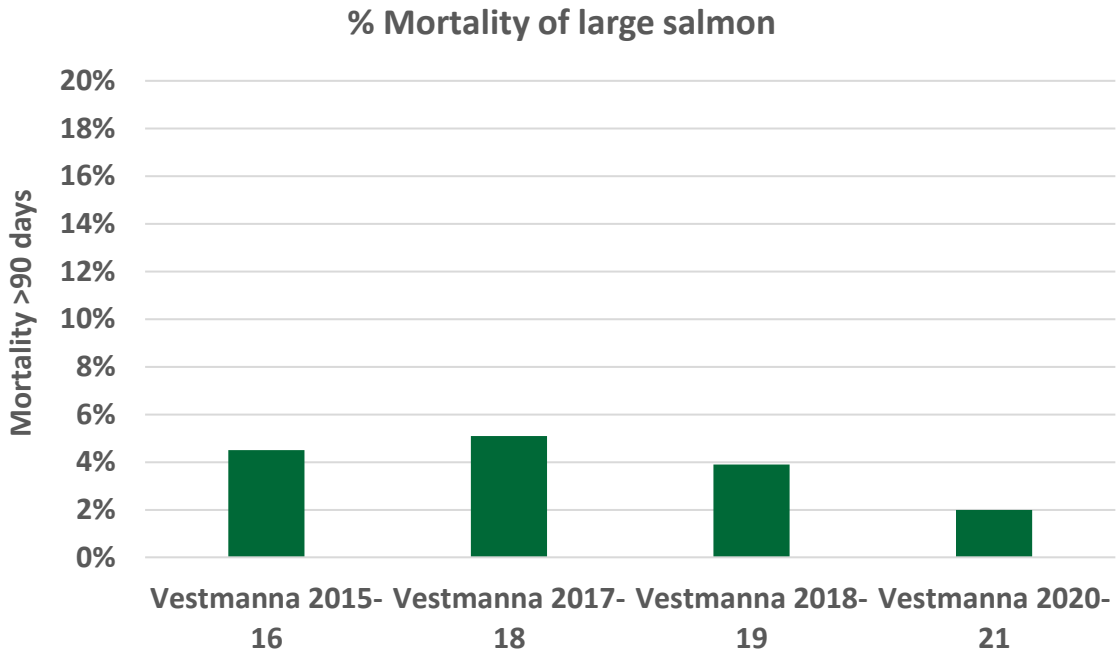
Vestmanna





					Deloused pens						
Production cycle	**Stocked salmon**	**Sea lice**	**Weight**	**Mortality >90dg**	**Slice**	**Salmosan**	**Diflu**	**Combi**	**Alphamax**	**Mechanic**	**Total**
Vestmanna 2015-16	1.2 mill	**8.7 mill**	6,2 kg	**4,5%**				10			**10**
Vestmanna 2017-18	1.8 mill	**3.4 mill**	5,7 kg	**5,1%**	12				5		**17**
Vestmanna 2018-19	1.5 mill	**2.7 mill**	6,4 kg	**3,9%**							**0**
Vestmanna 2020-21	1.5 mill	**4.8 mill**	7,6 kg	**2,0%**	14	2					**16**

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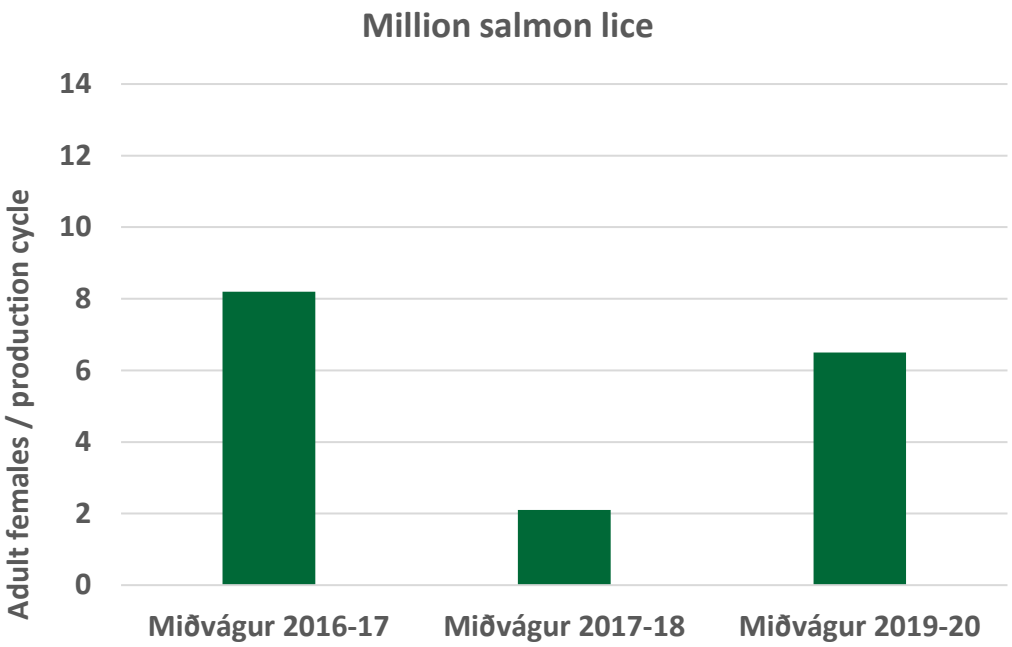
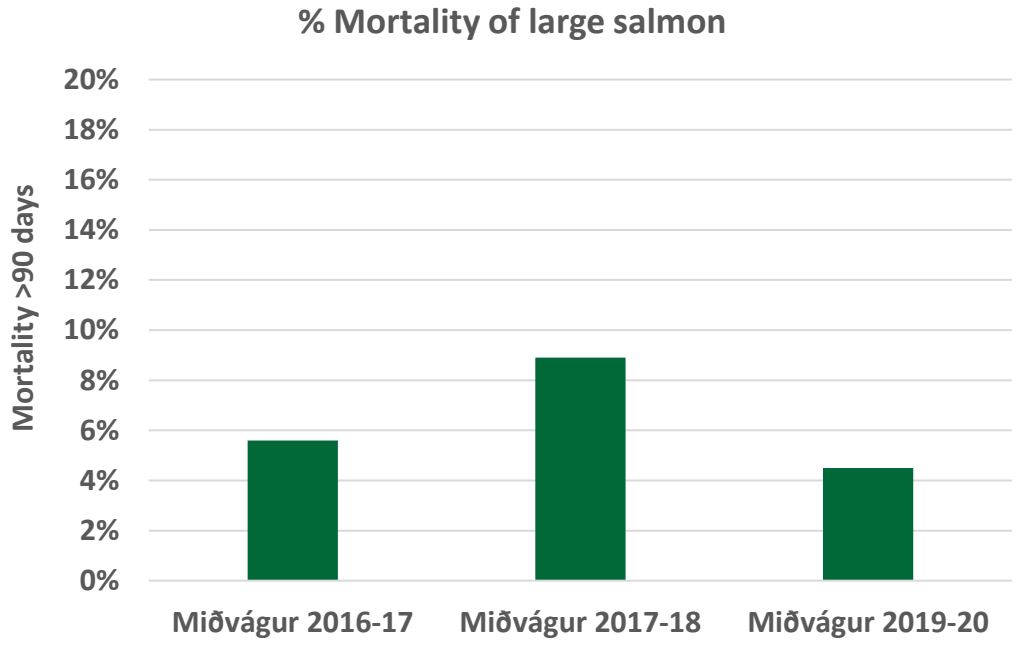
Miðvágur





					Deloused pens						
Production cycle	**Stocked salmon**	**Sea lice**	**Weight**	**Mortality >90dg**	**Slice**	**Salmosan**	**Diflu**	**Combi**	**Alphamax**	**Mechanic**	**Total**
Miðvágur 2016-17	**1.8 mill**	8.2 mill	5,4 kg	**5,6%**					7		**7**
Miðvágur 2017-18	**1.6 mill**	2.1 mill	5,2 kg	**8,9%**							**0**
Miðvágur 2019-20	**1.5 mill**	6.5 mill	5,9 kg	**4,5%**	12	6					**18**

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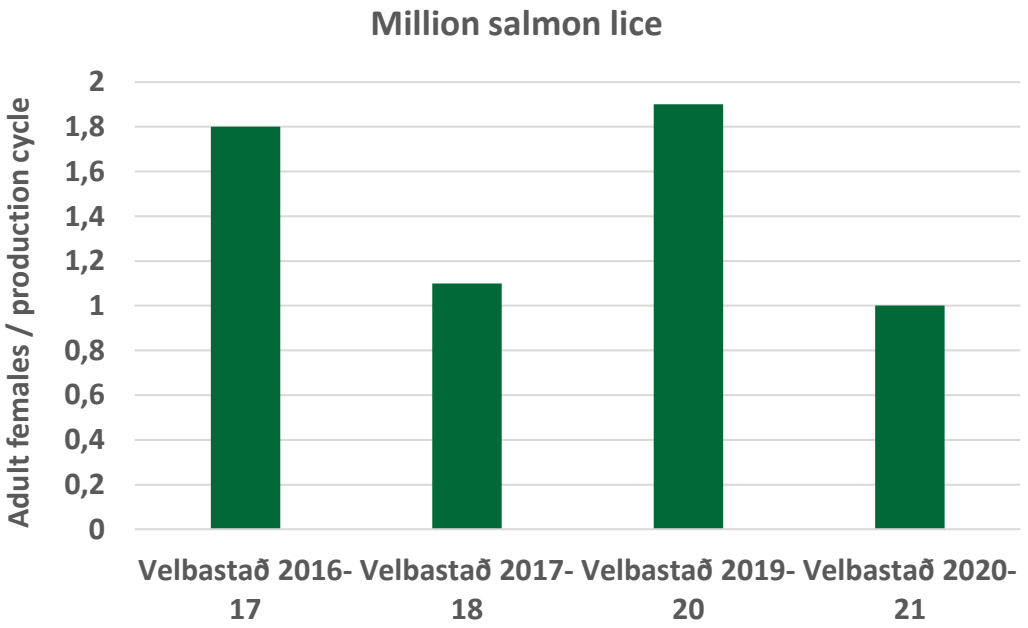
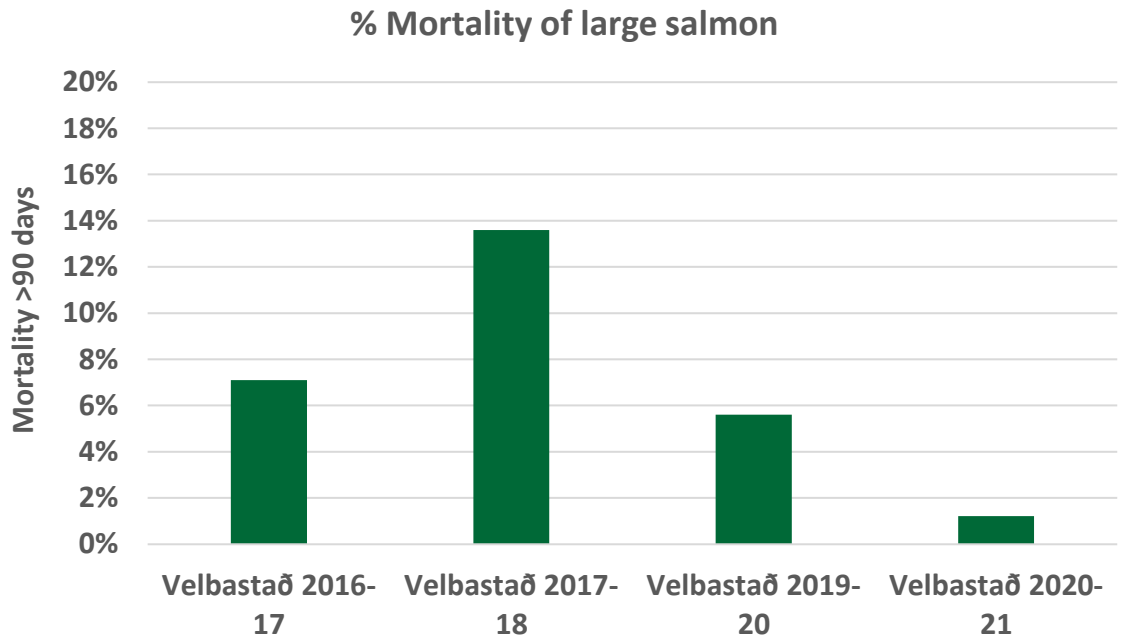
Velbastað





					Deloused pens						
Production cycle	**Stocked salmon**	**Sea lice**	**Weight**	**Mortality >90dg**	**Slice**	**Salmosan**	**Diflu**	**Combi**	**Alphamax**	**Mechanic**	**Total**
Velbastað 2016-17	0.3 mill	1.8 mill	5,9 kg	**7,1%**						3	**3**
Velbastað 2017-18	0.5 mill	1.1 mill	5,5 kg	**13,6%**	10		10				**20**
Velbastað 2019-20	0.5 mill	1.9 mill	6,0 kg	**5,6%**	5			5			**10**
Velbastað 2020-21	0.5 mill	1.0 mill	6,2 kg	**1,2%**	10	5					**15**

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Sea lice Hiddenfjord

2018:

19,3 % of production
8,3 % of the sea lice

2019:

18,6 % of production
11 % of the sea lice

2020:

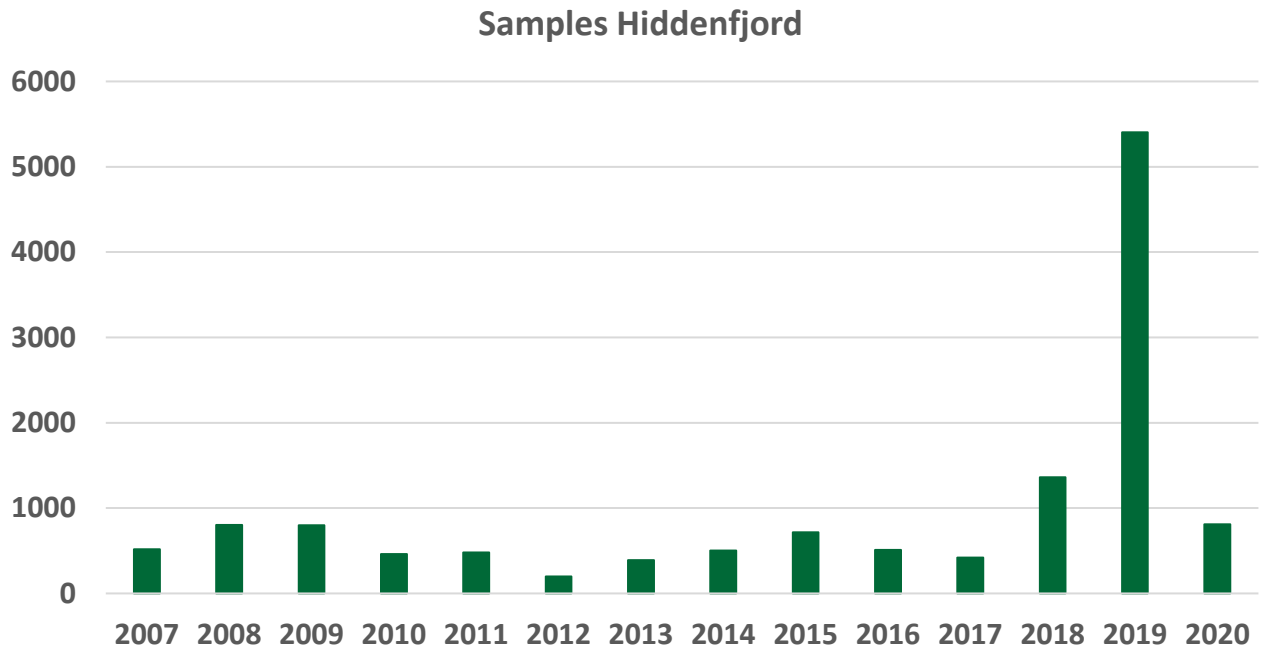
18,7 % of production
9,8 % of the sea lice

2021 so far:

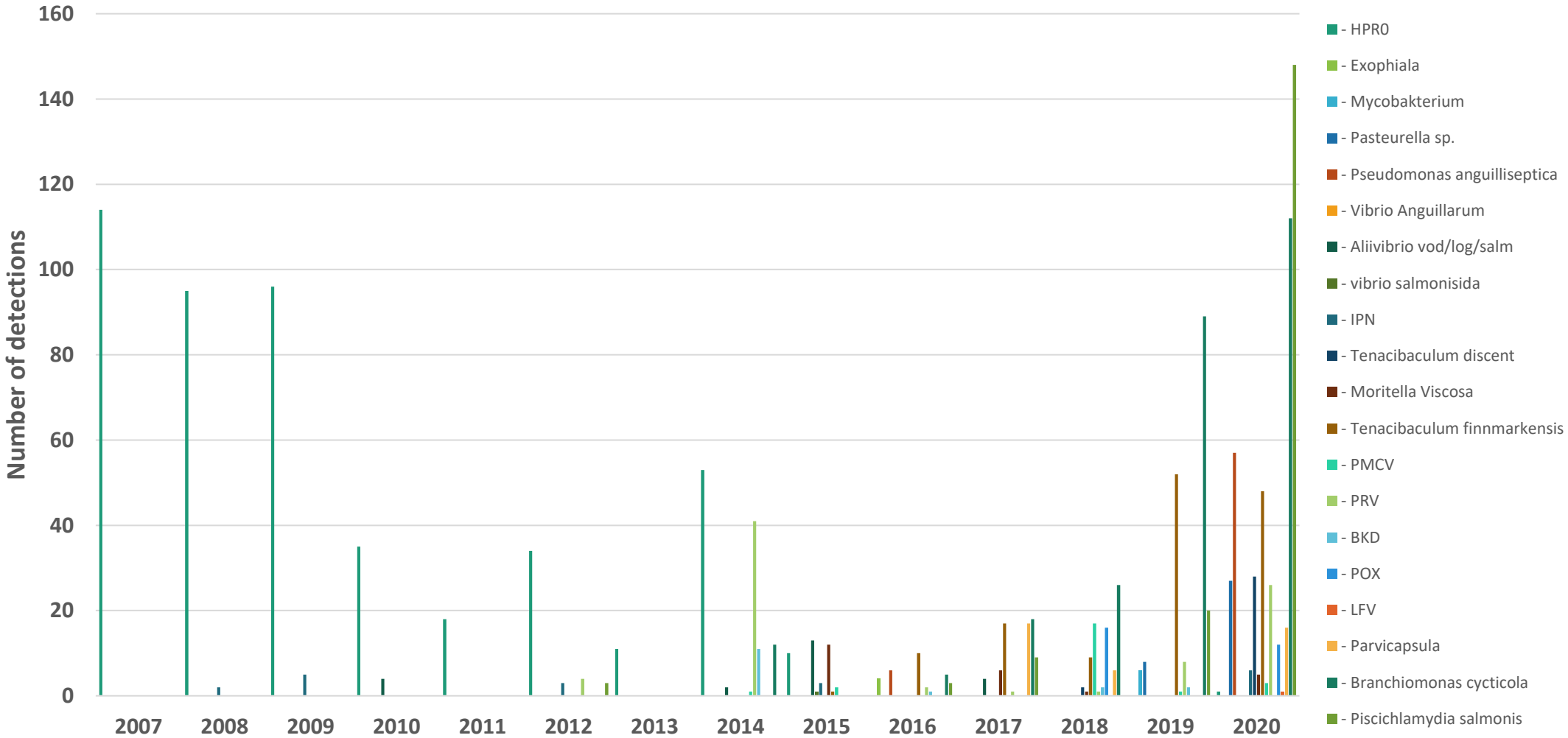
18,9 % of production
6,6 % of the sea lice

Disease surveilance

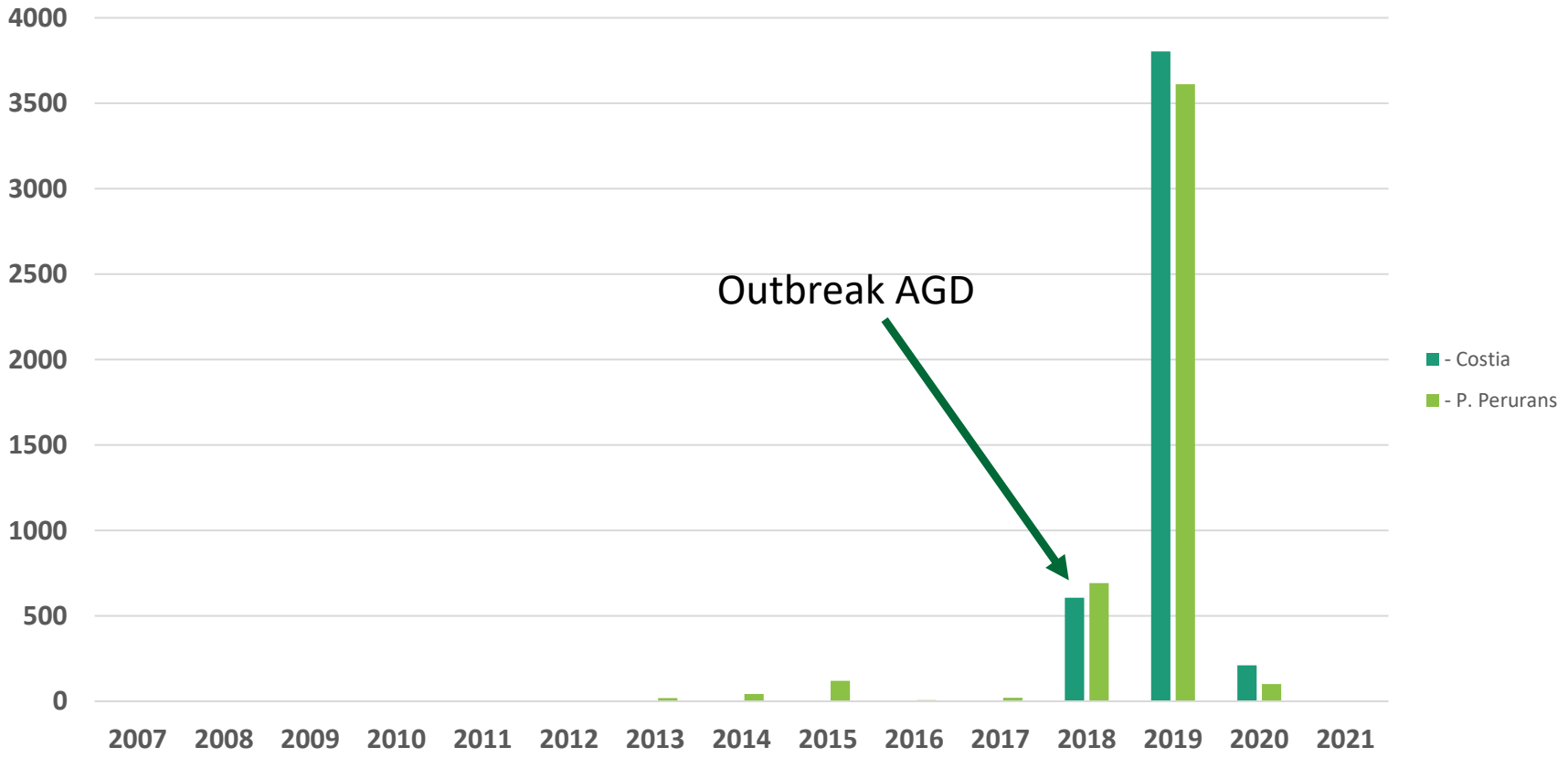
Disease surveilance



Detections (No outbreaks)

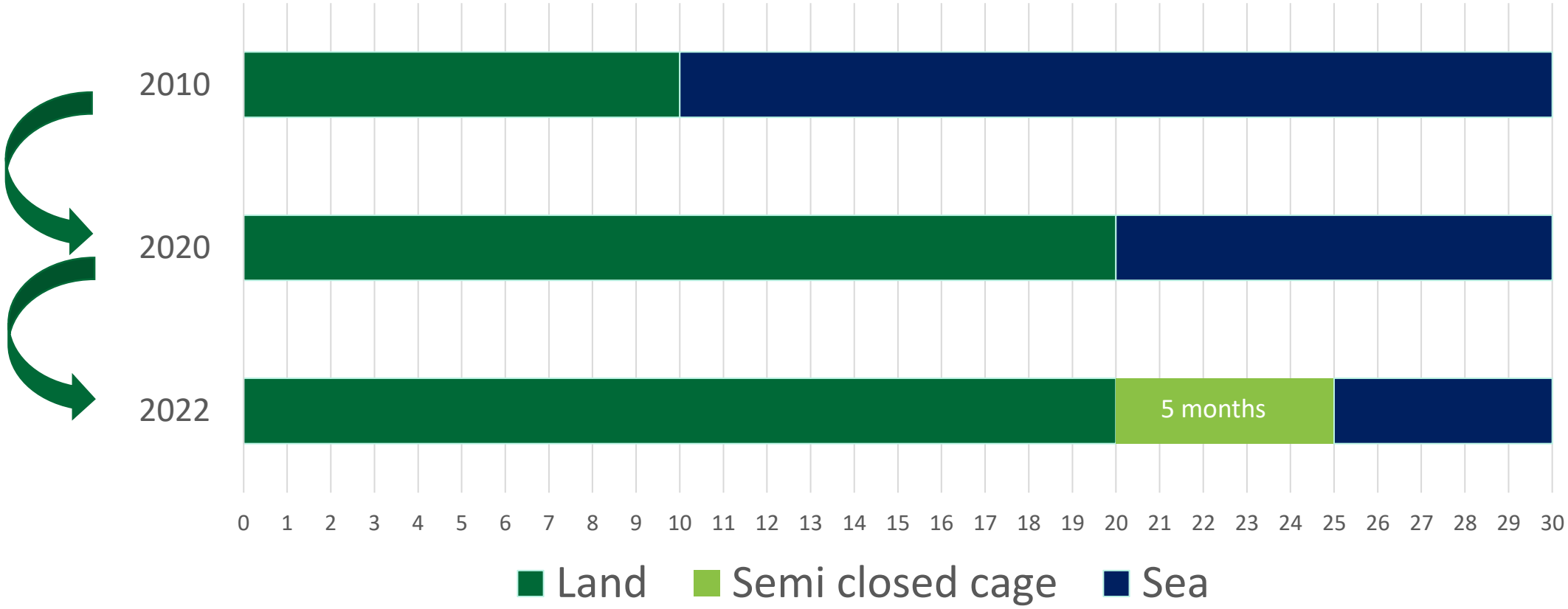


Detections and outbreaks

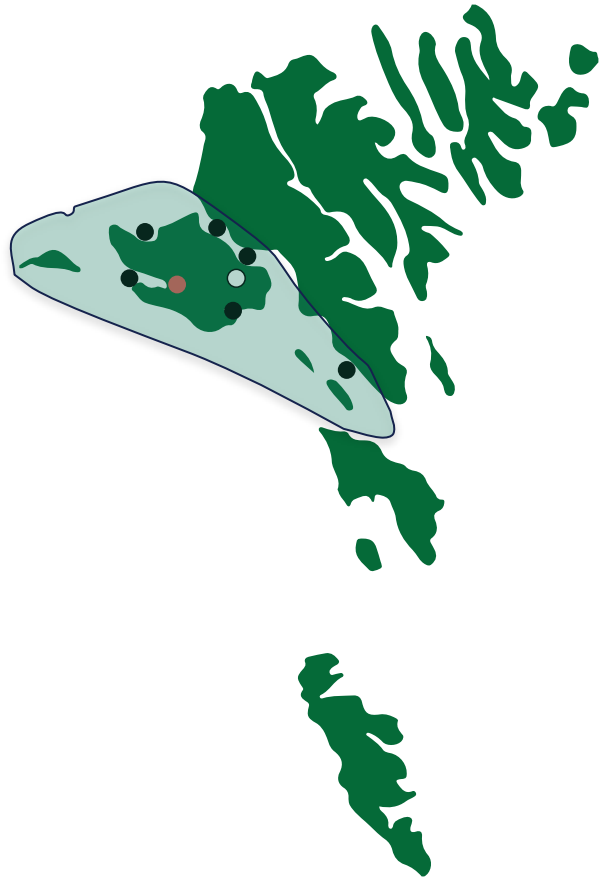


Semi Closed Containment System

Production time



The future



Continue with moving to exposed sites and/or expanding exposed sites

- Current barrier Suður í bug

Semi-closed-containment systems

Stricter regulations

Goal -> No handling and no chemical treatments

Salmon farming in the Faroes is under pressure

Too many sea lice – too high mortalities – **160** times above sea lice limit (1,0 adult females) since okt'17!

Hiddenfjord 7 times

Too many diseases -> Sea temperature increases –> AGD, other diseases?

HIDDENFJORD

RAISED IN THE WILD

Opinion – What should the industry focus on?

- Large smolts of good quality
- Fewer/equal number of smolts
- Fast growth on sea
- Lumpfish research – focus on getting mortality down!
- Genetics
- Sea lice modelling
- Strict sea lice regulations – Hiddenfjord wants 0,2 adult female limit
- Exposed farming
- Semi closed containment systems?

HIDDENFJORD
RAISED IN THE WILD

Takk fyri

HIDDENFJORD
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