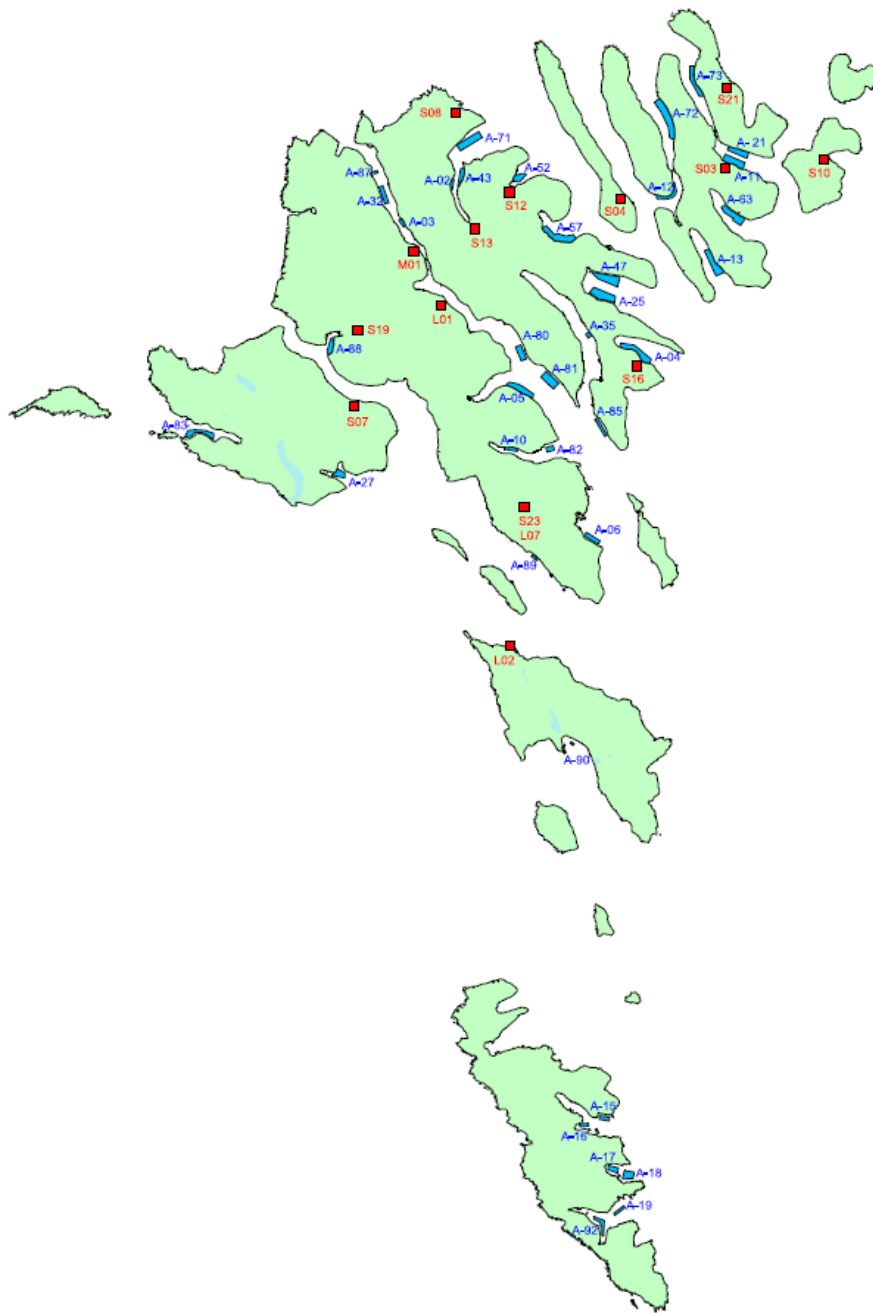




# Situation update from the Faroe Islands on CMS, HSMI and PD

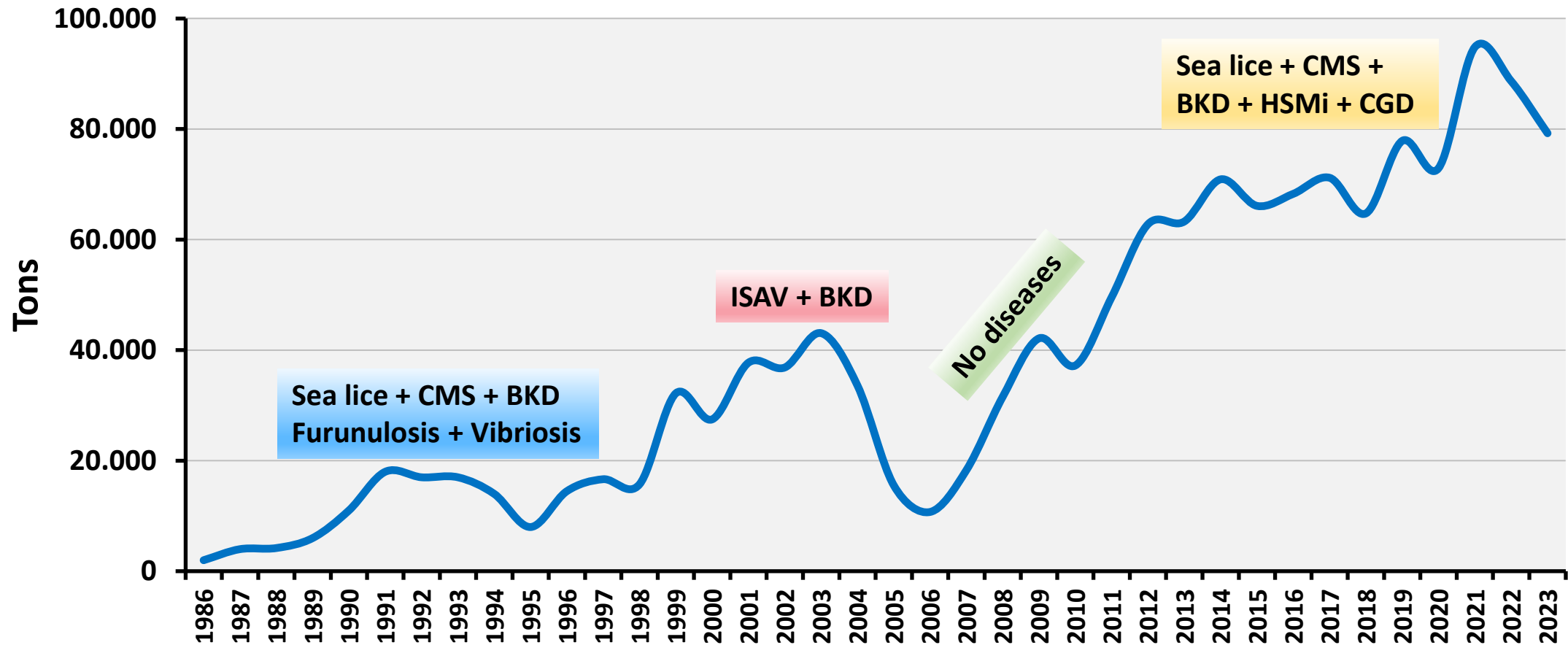
Debes Hammershaimb Christiansen  
Head of Department and Senior Researcher

# Faroese Aquaculture anno 2023

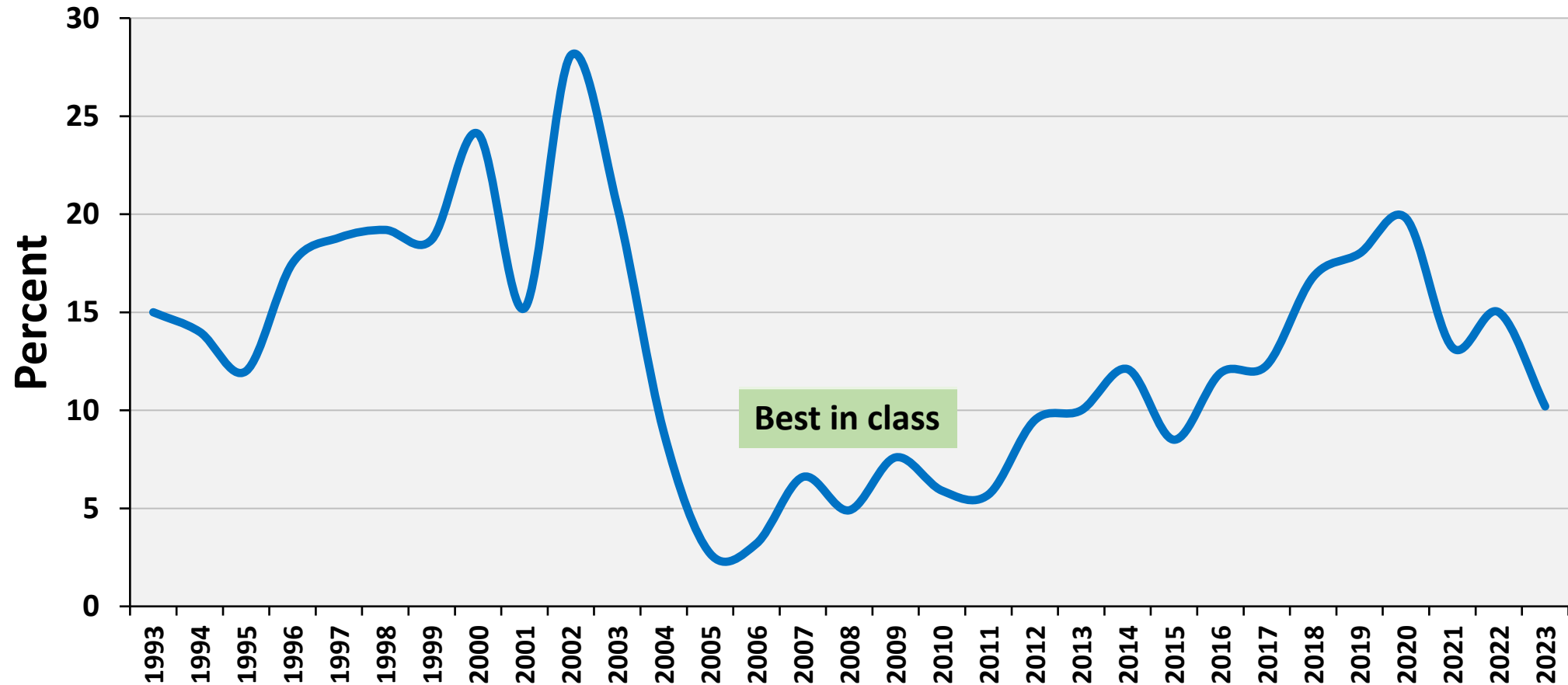


- 3 farming companies
- 2 Land based Brood stock facilities
  - One site for ova stripping and hatchery
  - One site for brood fish grow-out
- 8 Land-based hatcheries and smolt farms
  - RAS
  - Use freshwater only
- 28 Marine farms
  - 200 net pens with 20 mill Atlantic salmon at any time
    - 100.000 fish per net pen
  - 0.8 – 2 mio fish per site per production cycles

# Annual Atlantic salmon production

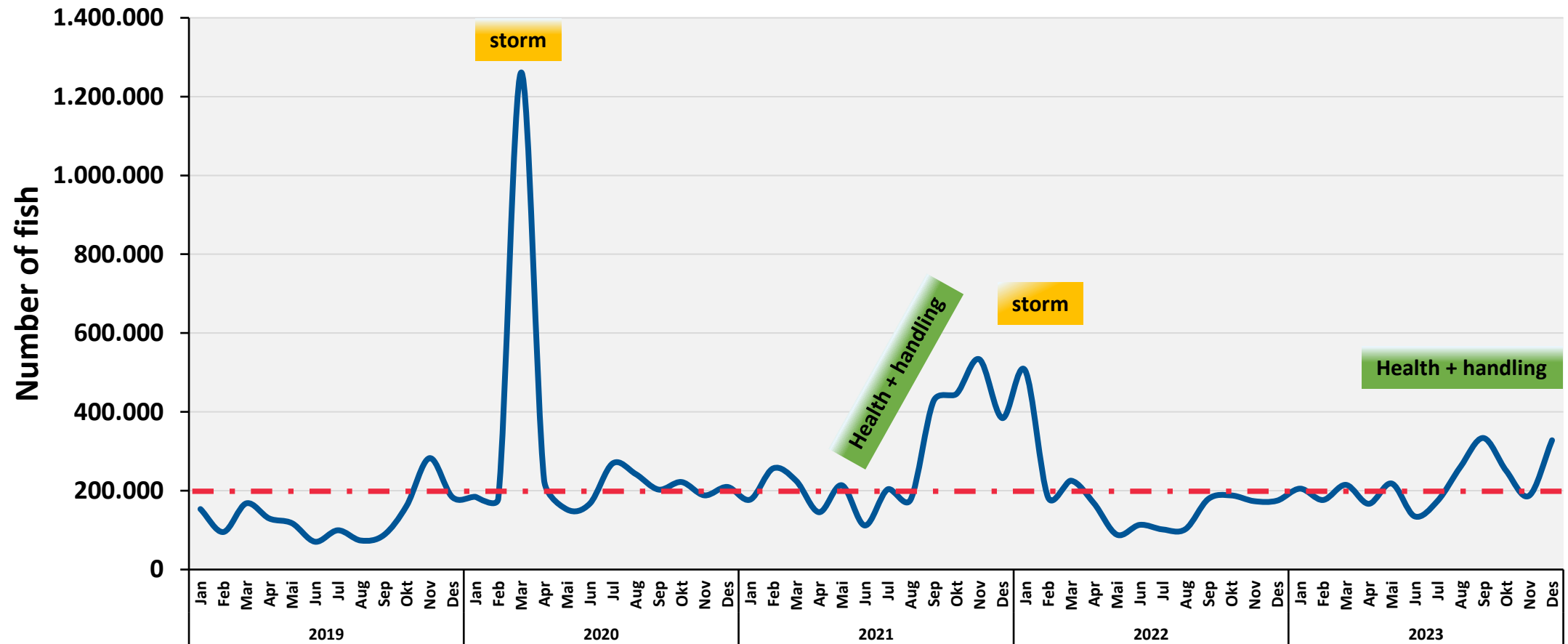


# Annual mortality of completed production cycles

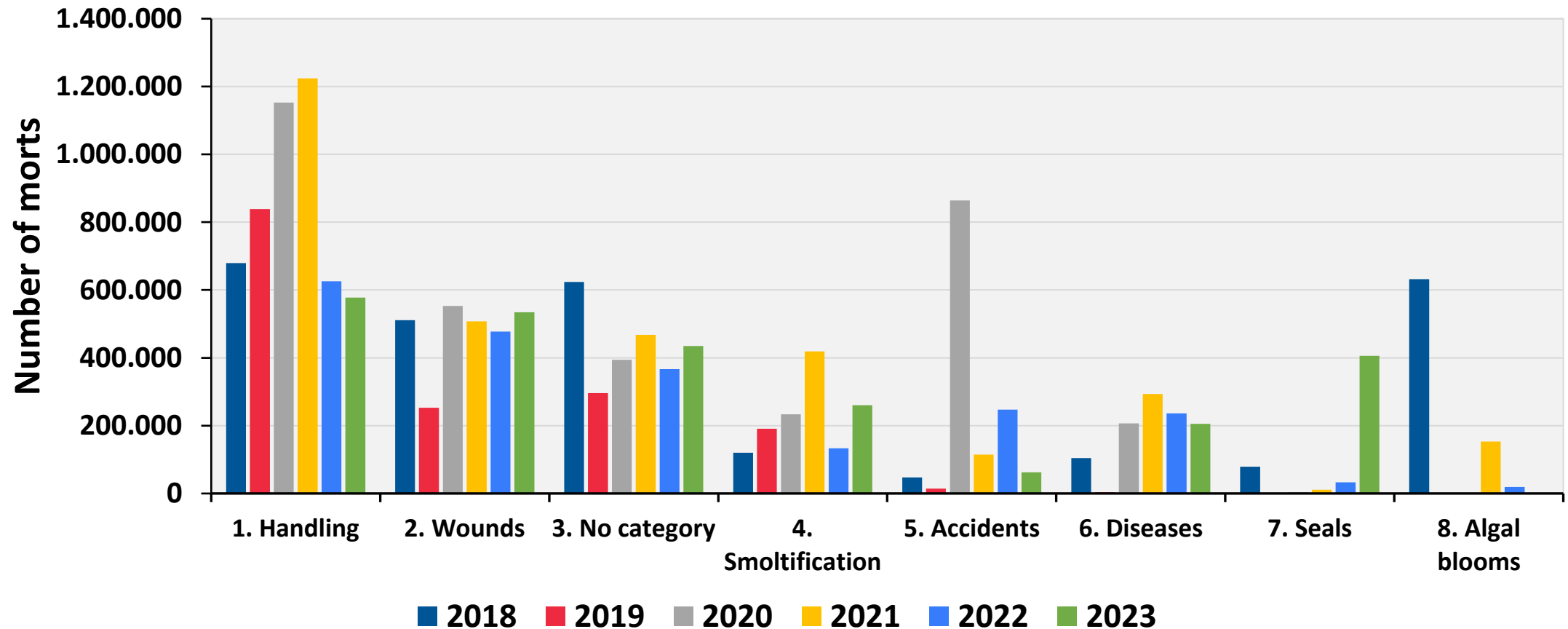


Rúni: AVRÍK

# Monthly mortality at marine production sites



# Main causes of mortality



# Prevalence of PMCV by RT-qPCR

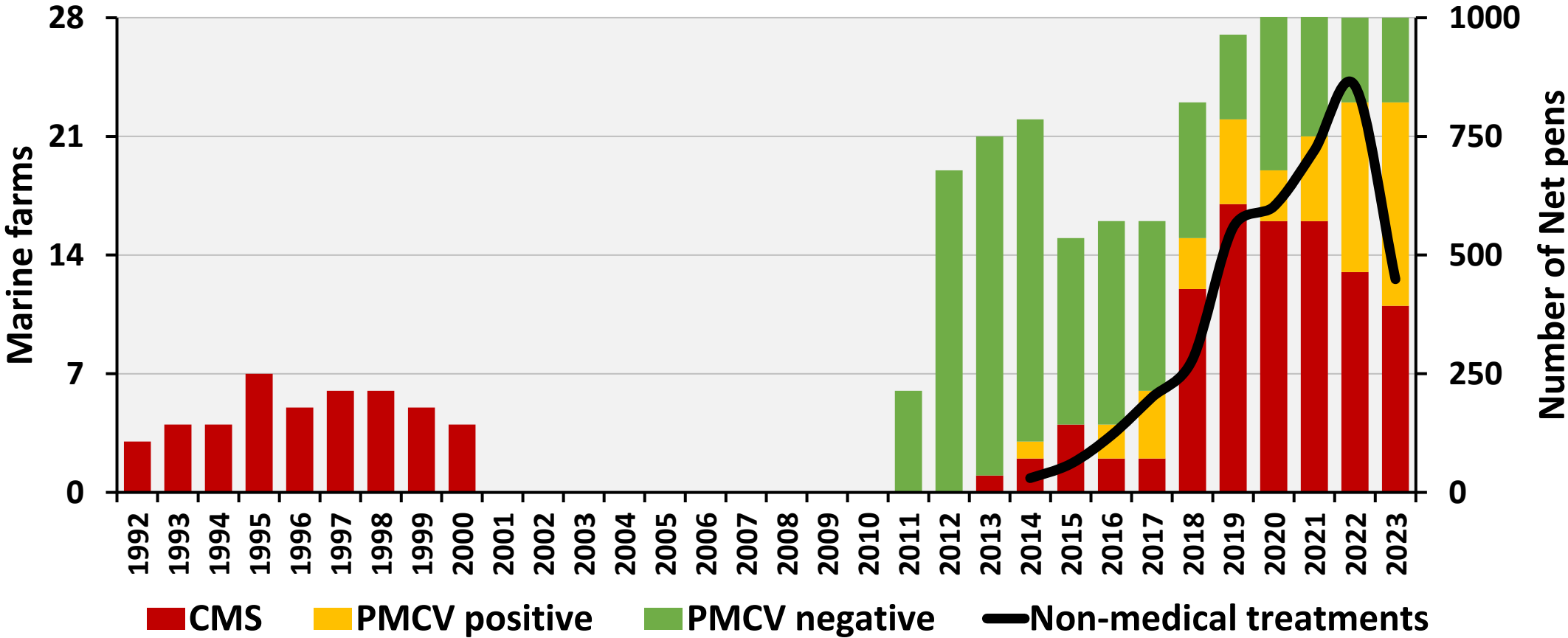
## Smolt farms

Year	Total number of fish	PMCV (N)		PMCV (%)		Ct-range
		≤35	≥36	≤35	≥36	
2011	40	0		0,0		
2012	325	0		0,0		
2013	14	0		0,0		
2014	82	0	1	0,0	1,2	38
2015	39	0		0,0		
2016	136	0	10	0,0	7,4	38 – 39
2017	338	0	2	0,0	0,6	39
2018	431	0	5	0,0	1,2	37 – 38
2019	786	36	27	4,6	3,4	16 – 37
2020	760	8	1	1,1	0,1	17 – 37
2021	879	1	4	0,1	0,5	35 – 37
2022	820	2	12	0,2	1,5	35 – 37
2023	1187	0	10	0,0	0,8	36 – 37
Total	5837	47	72	0,8	1,2	

## Marine farms

Year	Total number of fish	PMCV positive (N)	PMCV positive (%)
2012	749	0	0
2013	254	8	3,1
2014	595	116	19,5
2015	174	17	9,8
2016	185	30	16,2
2017	227	83	36,6
2018	2065	719	34,8
2019	2645	576	21,8
2020	2044	669	32,7
2021	2165	530	24,5
2022	1637	305	18,6
2023	2057	531	25,8
Total	14895	3584	24,1

# The prevalence of CMS seems to correlate with number of thermal treatments for sea lice





# Prevalence of PRV-1 by RT-qPCR

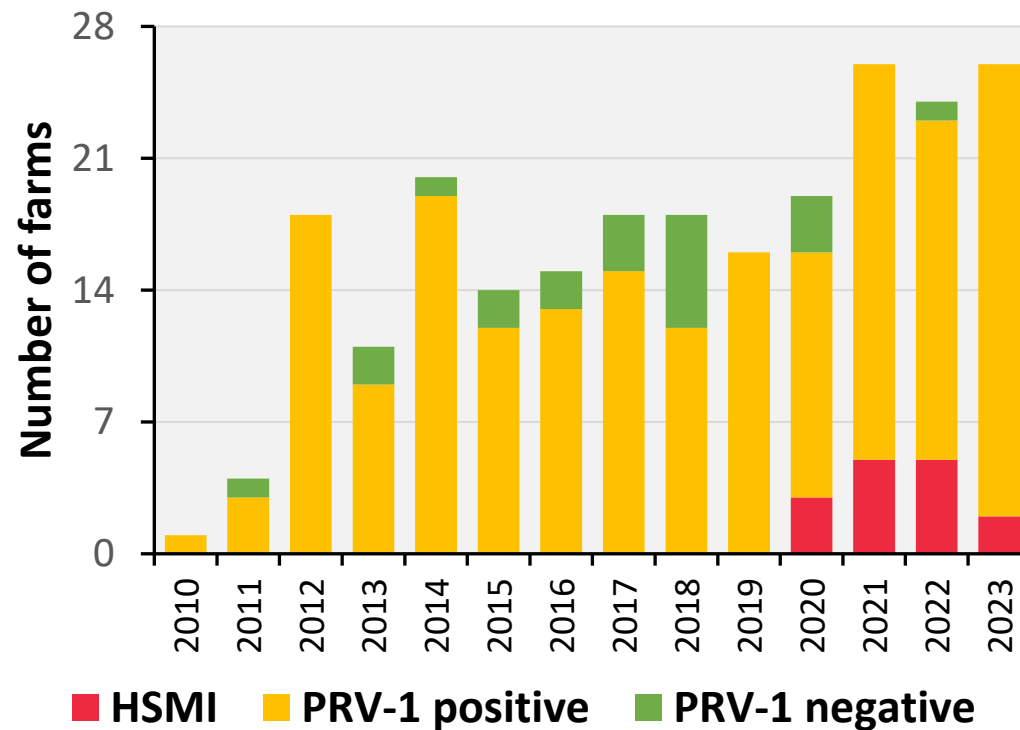
## Smolt farms

Year	Total number of fish	PRV-1 positive (N)	PRV-1 positive (%)
2011	240	229	95,4
2012	459	331	72,1
2013	60	32	53,3
2014	66	18	27,3
2015	145	86	59,3
2016	140	51	36,4
2017	372	100	26,9
2018	340	99	29,1
2019	371	84	22,6
2020	494	306	61,9
2021	664	385	58,0
2022	379	214	56,7
2023	833	528	63,4
Total	4563	2463	54,0

## Marine farms

Year	Total number of fish	PRV-1 positive (N)	PRV-1 positive (%)
2011	274	235	85,8
2012	550	390	70,9
2013	242	185	76,4
2014	480	300	62,5
2015	174	107	61,5
2016	180	103	57,2
2017	215	131	60,9
2018	750	133	17,7
2019	347	184	53,0
2020	303	180	59,4
2021	443	265	59,8
2022	354	179	50,6
2023	766	463	60,4
Total	5078	2855	56,2

# Over the last couple of years, we have seen some HSMI outbreaks

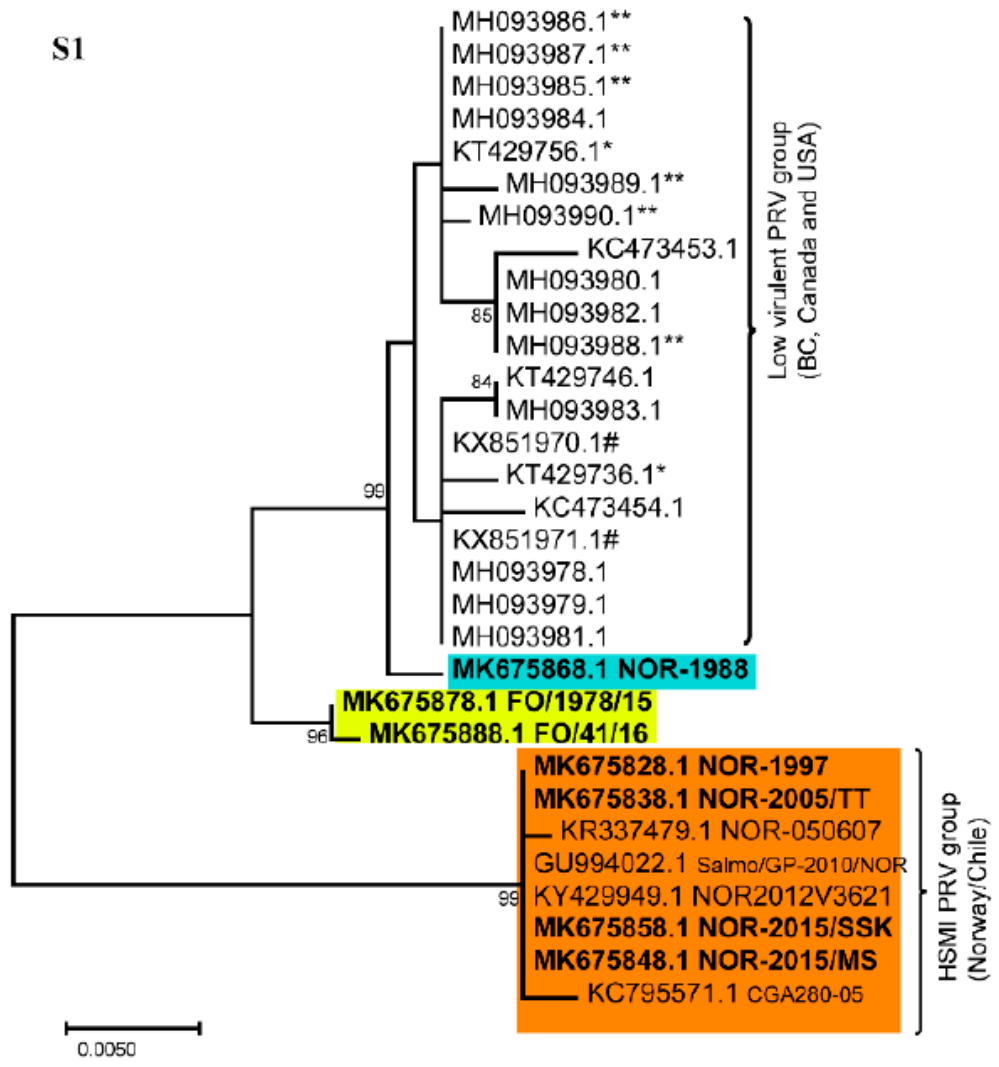


# Difference in virulence of PRV-1 is reflected in the genome



Article  
**Evolution of the *Piscine orthoreovirus* Genome Linked to Emergence of Heart and Skeletal Muscle Inflammation in Farmed Atlantic Salmon (*Salmo salar*)**

Kannimuthu Dhamotharan <sup>1</sup>, Torstein Tengs <sup>2</sup>, Øystein Wessel <sup>1</sup>, Stine Braaen <sup>1</sup>, Ingvild B. Nyman <sup>1</sup>, Elisabeth F. Hansen <sup>1</sup>, Debes H. Christiansen <sup>3</sup>, Maria K. Dahle <sup>4</sup>, Espen Rimstad <sup>1,\*</sup> and Turhan Markussen <sup>1</sup>



# Evolution of the *Piscine orthoreovirus* Genome Linked to Emergence of Heart and Skeletal Muscle Inflammation in Farmed Atlantic Salmon (*Salmo salar*)

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## 10 amino acids (aa) in $\sigma 3$ suggested to define low-versus high-virulent PRV-1

	60	70	80	90	100	110	120	130	140
NOR-1988	VGLSHNAKPTMVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRRGII EA								
FO/1978/15	VGLSHNAKPTMVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRROI EA								
KX851970	VGLSHNAKPTMVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRRGII EA								
KC47354	VGLSHNAKPTMVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRRGII EA								
KT439736	VGLSHNAKPTVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRRGII EA								
KT439746	VGLSHNAKPTMVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRROI EA								
MH093978	VGLSHNAKPTMVTHQCDGETLWDHSAPGDWTWSEWSYFVTSCANALSANADAYLRILTDKWTEDNSRGSNDRPDRRGII EA								
GU994022	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
KC795571	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
KR337479	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
KY429949	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
NOR-1997	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
NOR-2005/TT	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
NOR-2015/MS	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRRGV IEA								
NOR-2015/SSK	VGLSHNAKPTMVTHQCDGDTLWDHSTPGDWTWSEWSYFVTSCANALSANADAYLRILNDKWTEDNSRGSNDRPDRROI EA								

	150	160	170	180	190	200	210	220
NOR-1988	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
FO/1978/15	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
KX851970	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
KC473554	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
KT439736	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
KT439746	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
MH093978	KRRLRDDMRGIMKKKASGDLGLTGWLIIDPDELKSFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKVHVAAANQFPHKI IL							
GU994022	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
KC795571	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
KR337479	KRRLRDDMRGIMKKKTAGDLGLTDWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
KY429949	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
NOR-1997	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
NOR-2005/TT	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
NOR-2015/MS	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							
NOR-2015/SSK	KRRLRDDMRGIMKKKTAGDLGLTGWLIIDPDELESFDPDYSTEMTQLQEDMEELNPVEQKTGNNGGKAHVAAANQFPHKV IL							

# The Faroese PRV-1 variants causing HSMI also cluster in the Low-virulent PRV-1 group

NORWAY/144-85/2022 HSMI-QTL  
NORWAY-2005/TT  
NORWAY-2015/SSK  
NORWAY-2015/MS  
NORWAY-2018/SF  
NORWAY-2018/NL

HSMI

FO/940-03/2020 MARINE-B

FO/005-01/2023 SMOLT-D  
FO/003-01/2023 SMOLT-B  
FO/055-01/2022 MARINE-F  
FO/574-02/2021 MARINE-E  
FO/711-03/2019 SMOLT-G  
FO/171-05/2021 MARINE-D

HSMI

CANADA-2017

ISL/775-08/2011

NORWAY-1921  
NORWAY-1988

FO/470-02/2021 SMOLT-A  
FO/041-01/2016 MARINE-A  
FO/092-02/2021 SMOLT-C

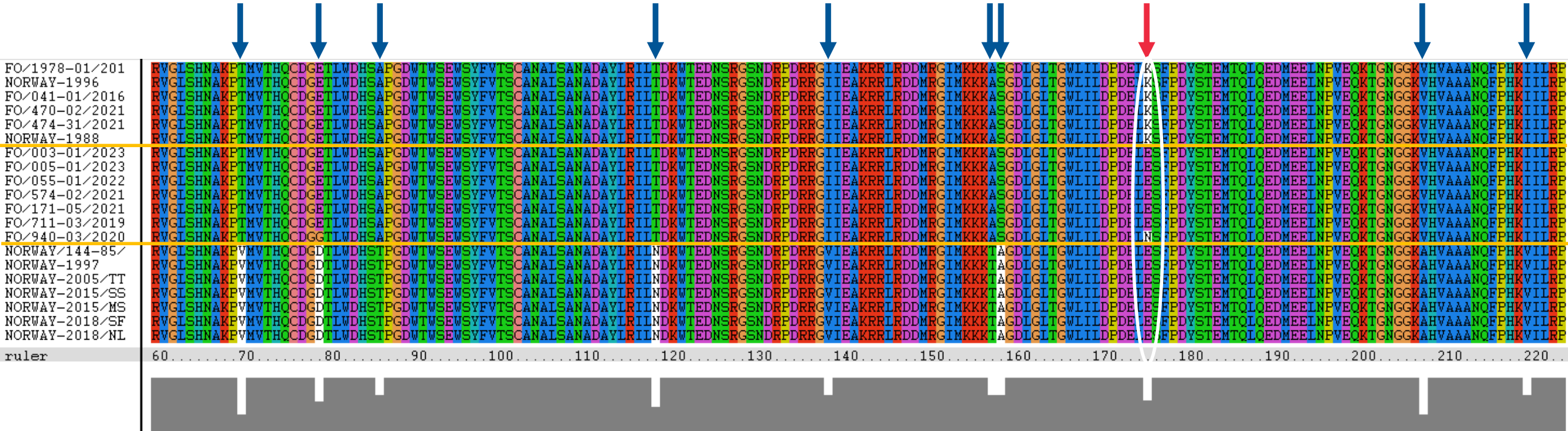
FO/1978-01/2015 SMOLT-B  
NORWAY-1996  
DK-14-15958-4  
DK-2013-50-282-20  
DK-2013-50-288-63  
GREENLAND-2017a  
DK-2013-50-282-11  
GREENLAND-2016  
NORWAY-3817  
GREENLAND-2017b  
NORWAY-5433

No HSMI

- Increased mortality
- PRV-1 Ct-values 13 – 20
- Clinics consistent with HSMI
- Histology consistent with HSMI

0.01

# Most Faroese PRV-1 variants associated with HSMI carry low-virulent aa in $\sigma 3$ except for one aa



# SPDV/SAV has newer been detected in the Faroes

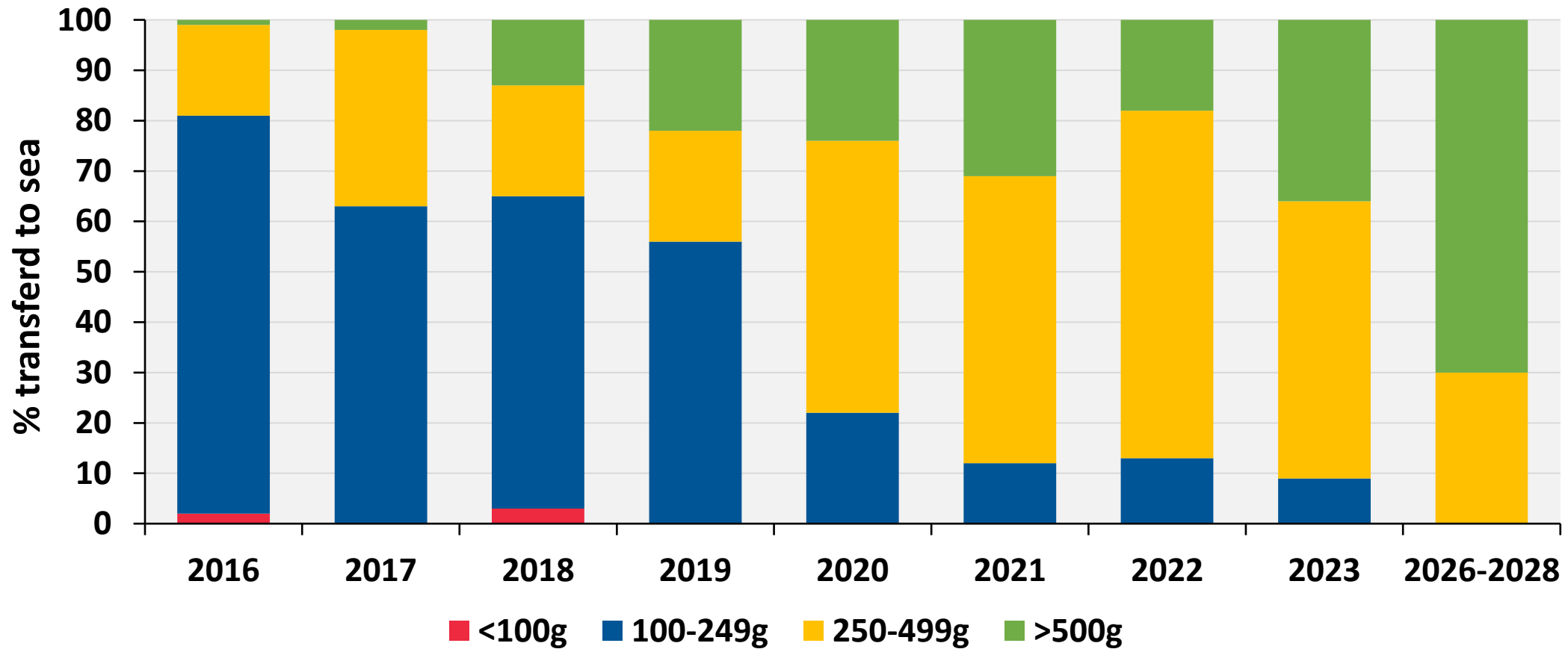
## Smolt farms

Year	Total number of samples	PRV-1 positive (N)	PRV-1 positive (%)
2011	16	0	0
2012	18	0	0
2013	369	0	0
2014	22	0	0
2015	20	0	0
2016	142	0	0
2017	138	0	0
2018	160	0	0
2019	132	0	0
2020	123	0	0
2021	210	0	0
2022	166	0	0
2023	151	0	0
Total	1667	0	0

## Marine farms

Year	Total number of samples	PRV-1 positive (N)	PRV-1 positive (%)
2011	11	0	0
2012	64	0	0
2013	2048	0	0
2014	2315	0	0
2015	1614	0	0
2016	2500	0	0
2017	1962	0	0
2018	1714	0	0
2019	1607	0	0
2020	1808	0	0
2021	1936	0	0
2022	1389	0	0
2023	1558	0	0
Total	20526	0	0

# Production of large-smolt is one of the main strategies to reduce handling and disease related mortalities at marine sites





Freshwater and FSL treatment for sea-lice is much less stressful for the fish compared to thermolicer/optilicer



# Summary

- Decreasing number of CMS outbreaks
  - Production of large smolt has reduced time at sea
    - Reduced number of treatments for sea lice
  - More gentle handling of the fish during delousing
    - Thermolicer/Optilicer >> Freshwater and FLS
  - Prevent spreading pathogens between sites with well-boats and vessels
    - After cleaning/disinfection, swabs and water samples are collected and tested for relevant pathogens
- Increasing number of HSMI
  - Genetics of fish? – virulence of PRV-1? – environment?
- No PD

A wide-angle landscape photograph of a fjord in the Faroe Islands. The scene features a calm, blue body of water in the foreground, with a small boat visible in the middle ground. The surrounding hills are covered in lush green grass, and the sky is a vibrant blue with scattered white clouds. In the distance, more rugged, rocky islands are visible, some partially shrouded in mist. A small, dark wooden building with a green roof sits on a grassy slope in the lower right foreground.

# Thank you

Mynd: Peter S. Østergaard