PMCV-FoNET

PMCV in Faroese brood stock

BAKKAFROST
ESTABLISHED 1968

Hiddenfjord

MOWI

JAVRIK

AQUAMED

Andras Strøm

FRÓÐSKAPARSETUR FØROYA
UNIVERSITY OF THE FAROE ISLANDS

Cardiomyopathy Syndrome (CMS)

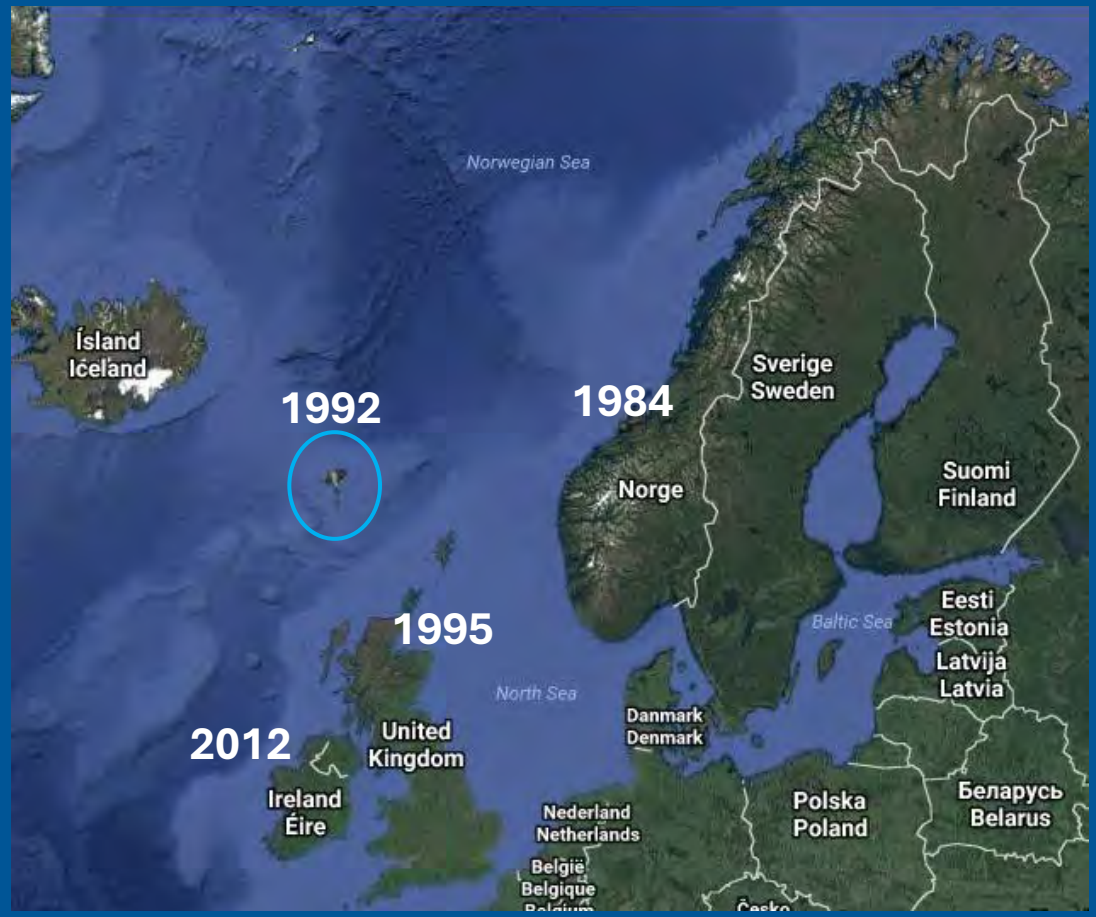
CMS is a serious heart disease in farmed Atlantic salmon.

First reported:

- Norway 1984
- Faroe Islands 1992
  - Faroe Islands 2013
- Scotland 1995
- Ireland 2012

Never reported:

- Chile
- Iceland

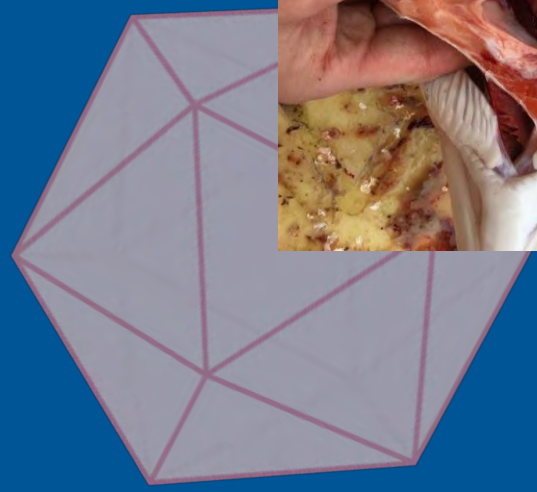


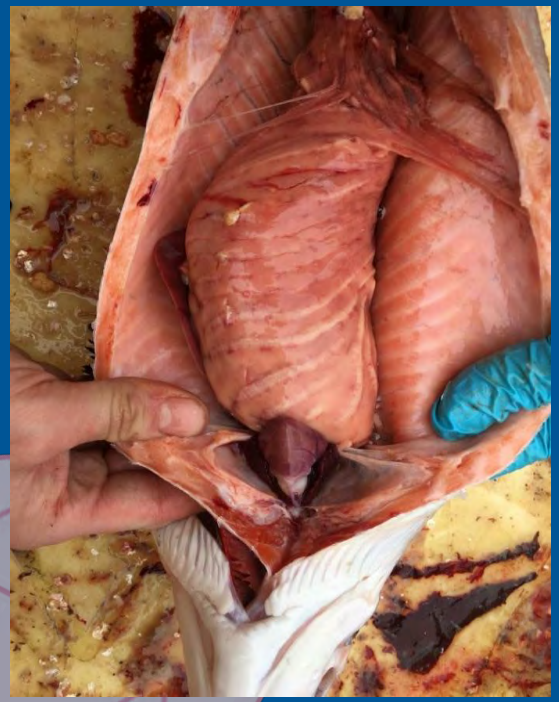
Piscine myocarditis virus (PMCV)

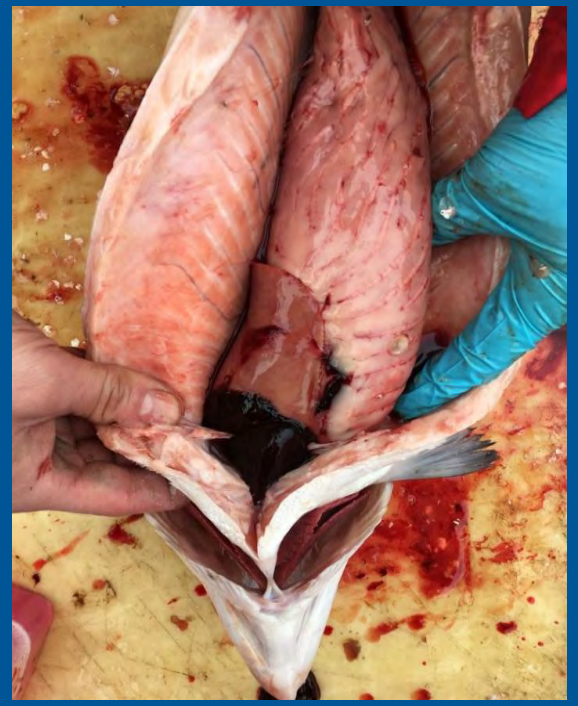
Causative agent identified in 2010:

Piscine myocarditis virus (PMCV)

- dsRNA virus







- No current method of culturing
- Limited knowledge of:
  - transmission pathways
  - possible virulence markers
  - Cell entry mechanism

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MICROBIOLOGY SOCIETY

OPEN ACCESS

Genomic analysis reveals low genetic diversity and no continuous reintroduction of piscine myocarditis virus in farmed Atlantic salmon in the Faroe Islands

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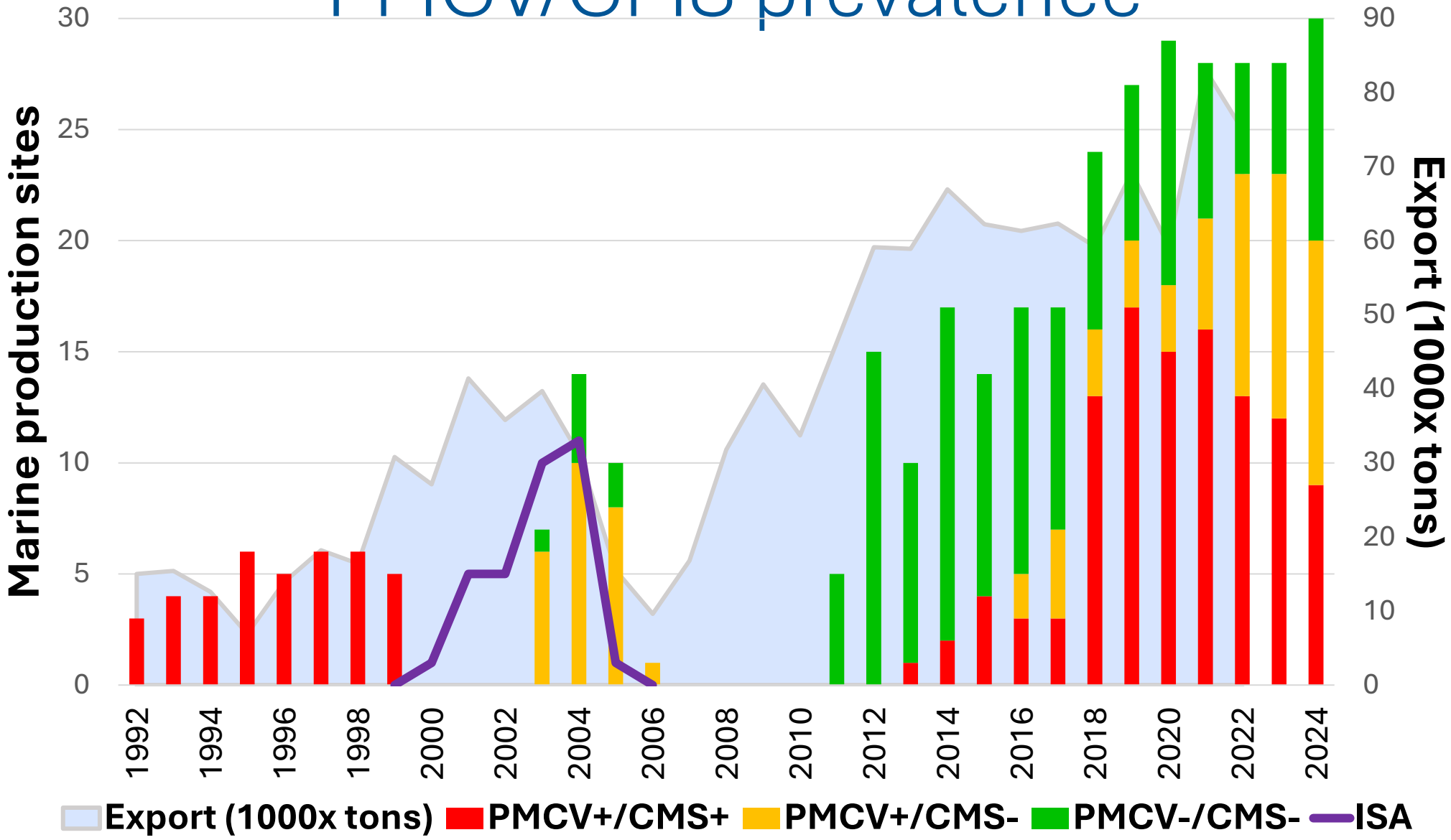
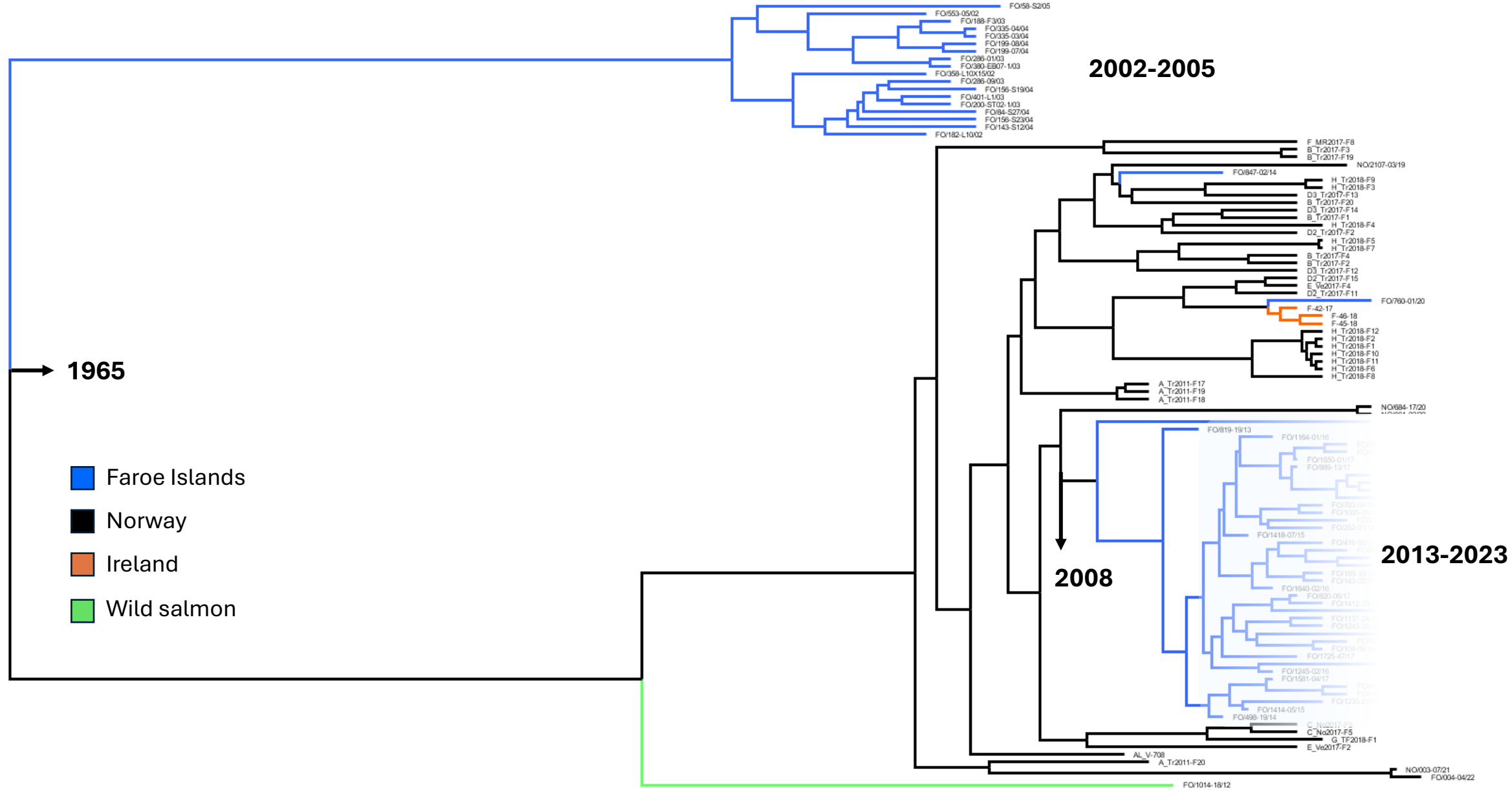
Abstract

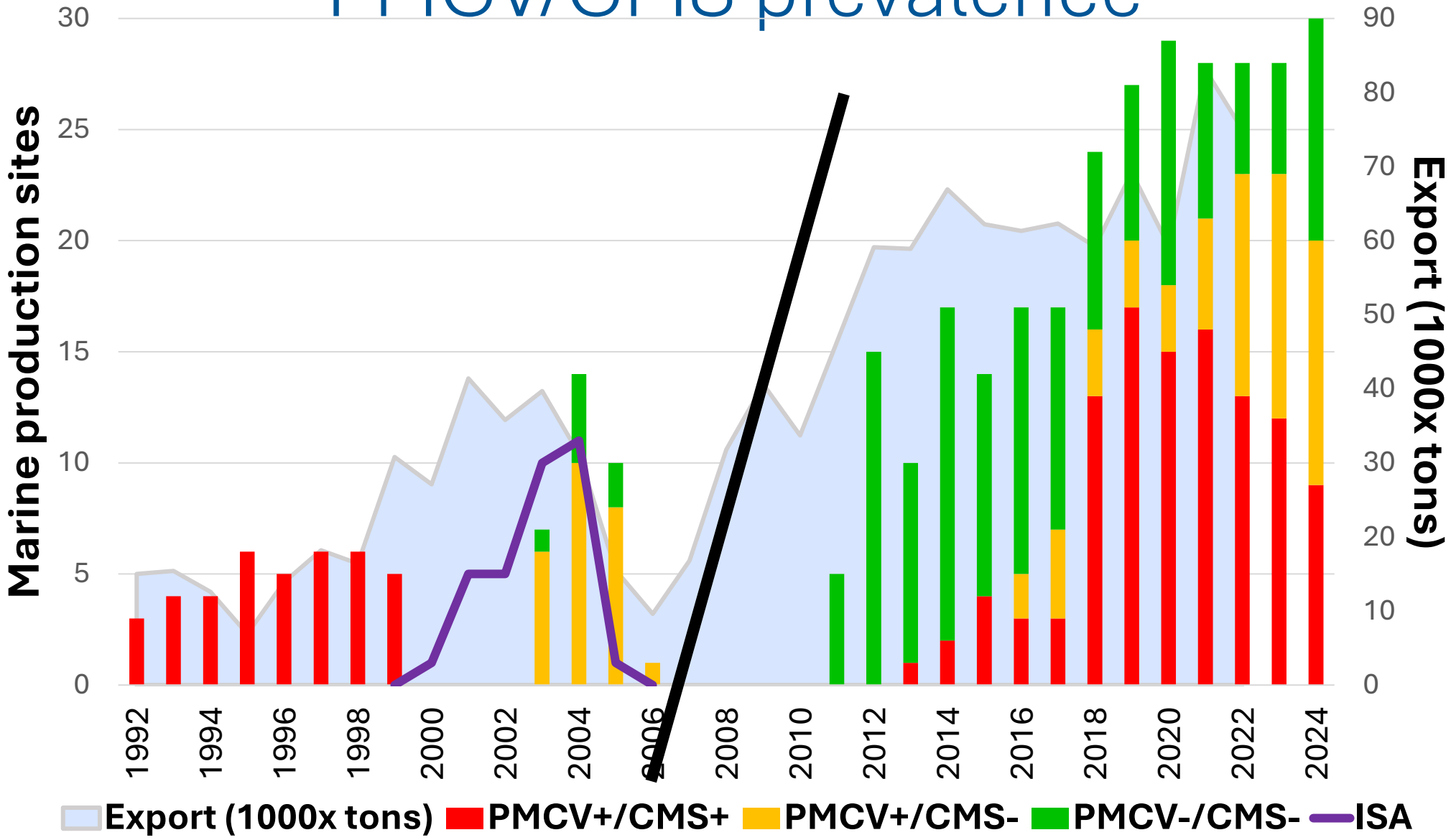
Piscine myocarditis virus (PMCV) is the causative agent of cardiomyopathy syndrome (CMS), a significant disease in farmed Atlantic salmon (*Salmo salar* L.). Although an increasing number of CMS outbreaks have been recorded in the Faroe Islands since the reemergence of CMS in 2013, overall PMCV genetic diversity, transmission pathways and evolutionary trajectories remain elusive. Here, we present a fast amplicon-based whole-genome sequencing method of PMCV directly from field samples and disclose 48 novel genomes, adding to the single genome currently available. Phylogenetic analysis revealed that genomes with a broad spatiotemporal representation of Faroese farmed salmon formed a homogenous monophyletic cluster compared to Norwegian and Irish PMCV genomes. Homogeneity of the Faroese genomes was substantiated with principal component analyses, where no spatiotemporal clustering of genotypes was found, nor any clustering based on roe or smolt origin. One genome from a returning wild salmon differed considerably from all the rest and formed an outgroup. All three ORFs exhibited signs of purifying selection, although ORF3 displayed a comparatively lower degree of selective constraint. Furthermore, no virulence-determining amino acid substitutions were identified in the Faroese genomes as no association was found between CMS cases and specific amino acid substitutions or motifs. Our data suggest that PMCV was introduced into the Faroe Islands from Norway, where brood fish is known to be infected. However, despite a steadily increasing import of Norwegian roe, our results show no continuous reintroduction of persisting PMCV strains to Faroese farmed salmon.

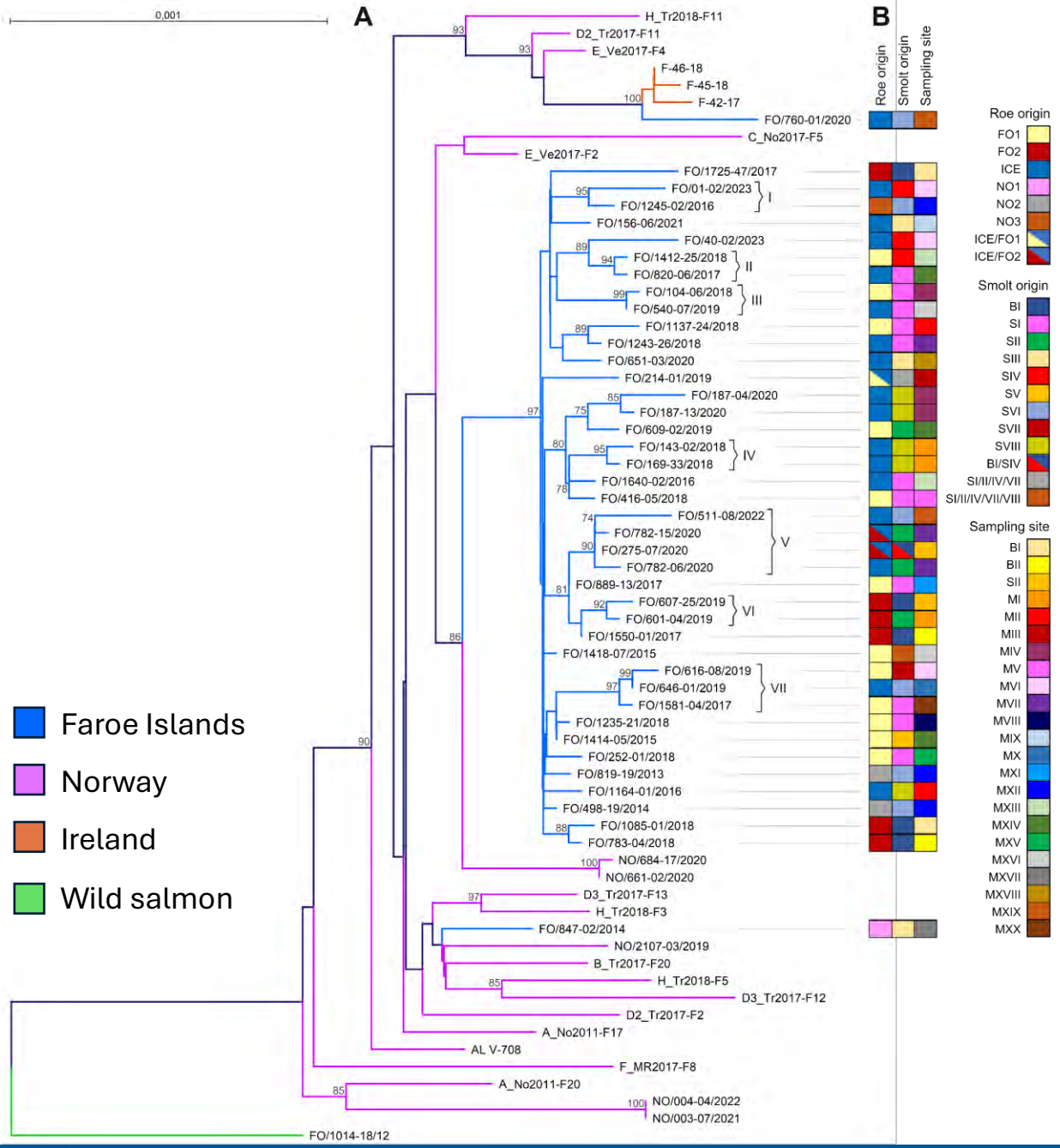
PMCV/CMS prevalence




2002-2005
1965
2008
2013-2023
Faroe Islands
Norway
Ireland
Wild salmon
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024

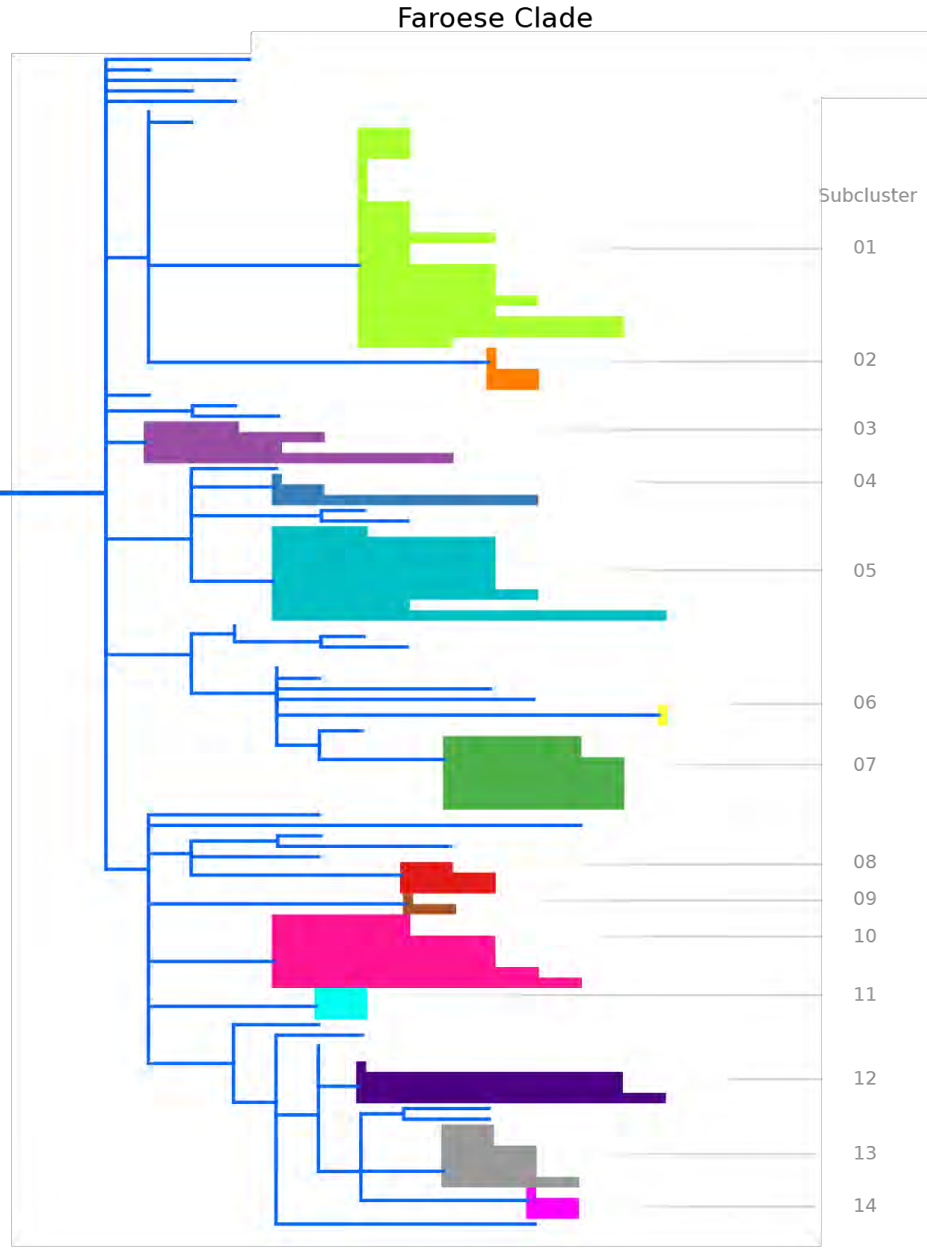
PMCV/CMS prevalence





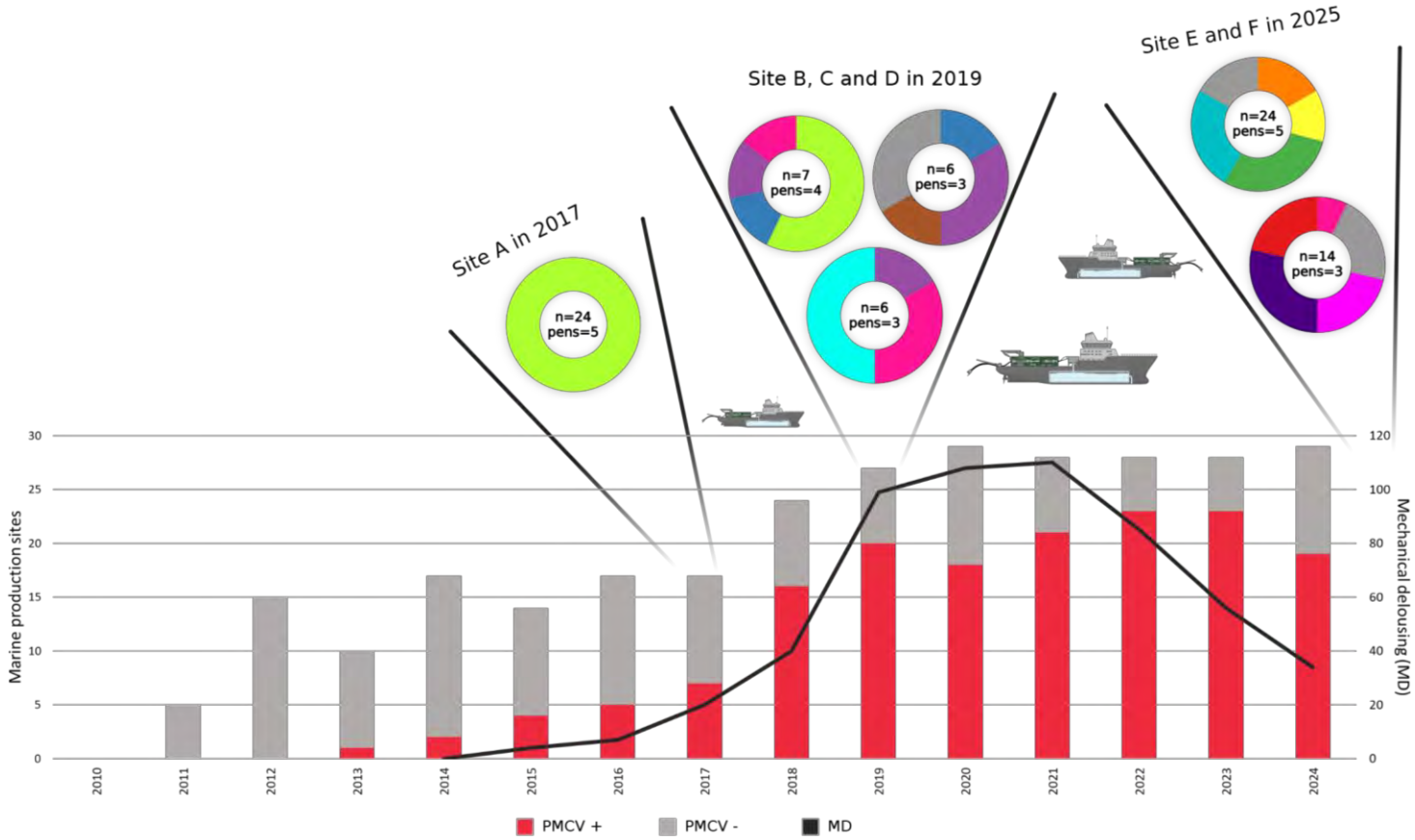
PMCV 2013 - 2023

- Monophyletic Faroese cluster
  - **Faroese clade**
- Very homogenous
  - min. 99,7% identical
- Clustering within the Faroese clade no association with:
  - Roe origin
  - Smolt origin
  - Sampling site



In-site variation

- Faroese PMCV remains a single clade
- diversity within farms has expanded over time
  - PMCV is allowed to persist

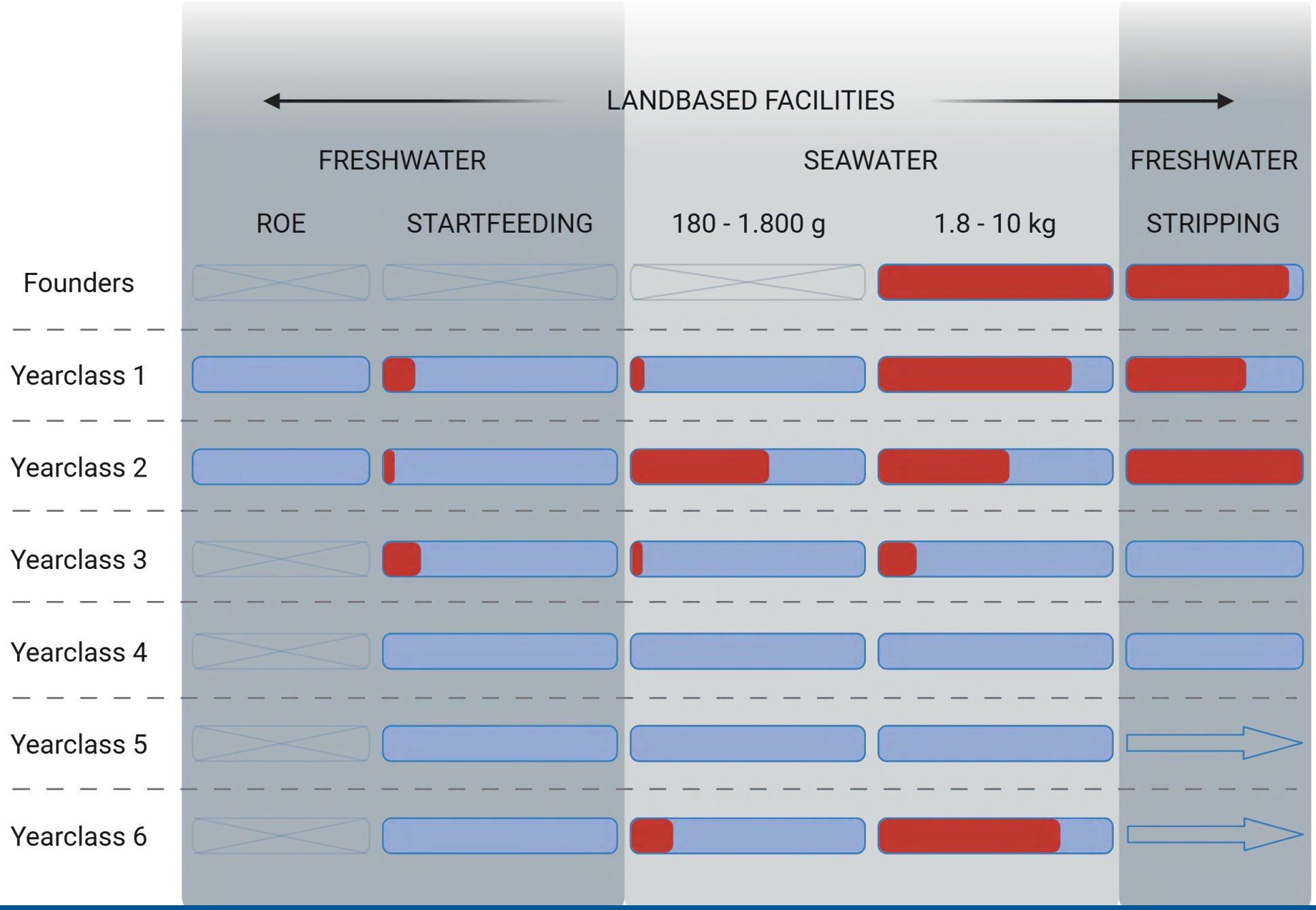


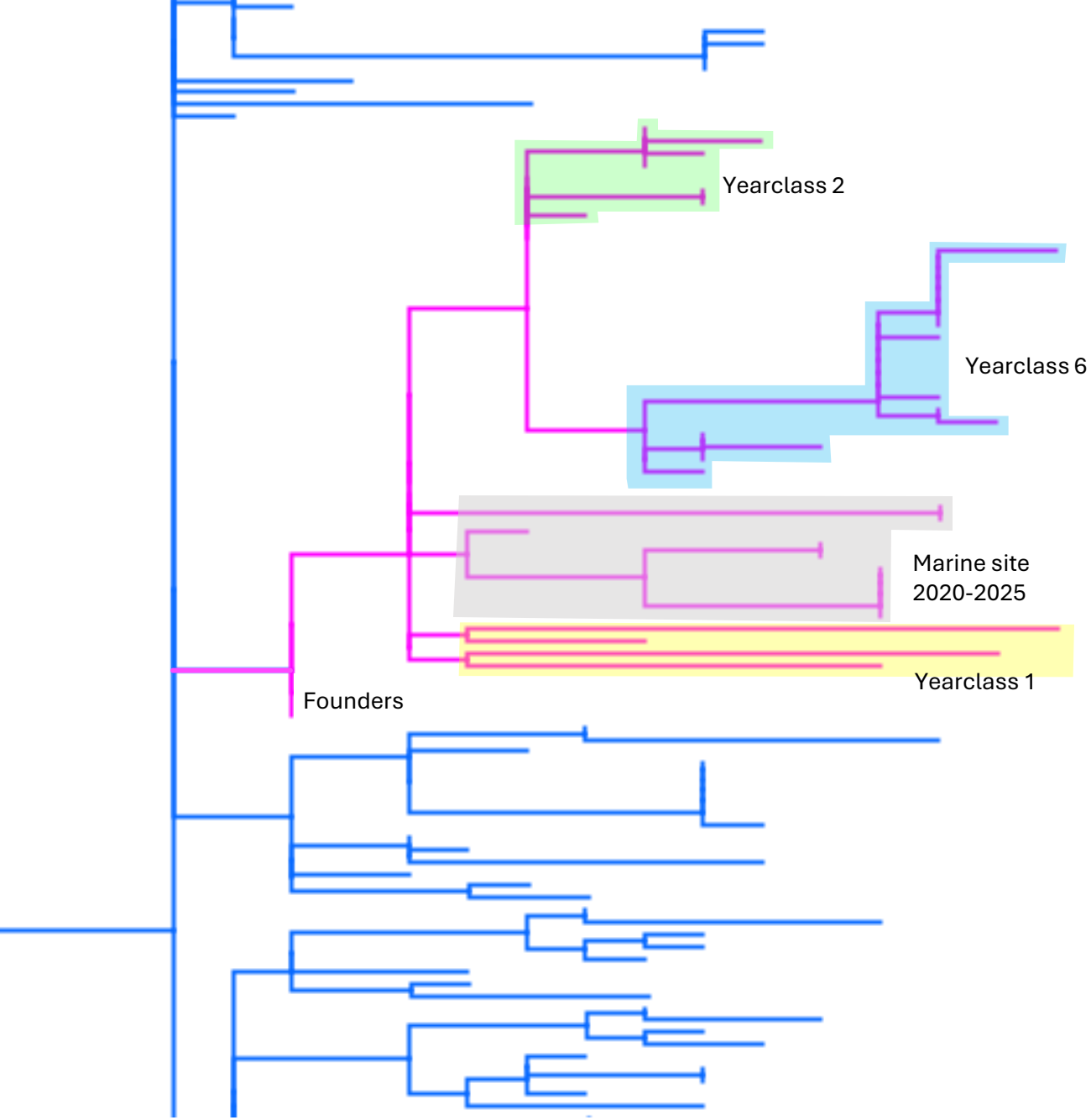
Faroese brood stock

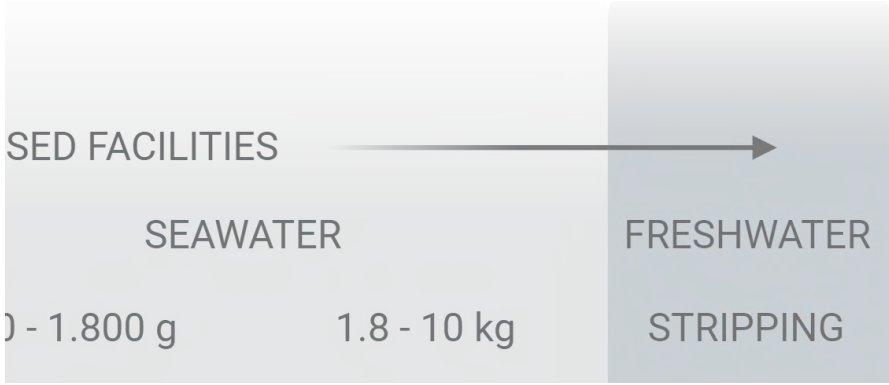
- Faroese brood stock from 1978
  - Roe originating from Norway
  - Landbased facilities only
  - Never tested PMCV positive
  - Not competitive production
  - Last stripping in 2013

- Last of the brood stock in two marine netpens
  - Founders
  - PMCV positive
  - Low Ct values but no mortality

- Re-established in 2017
  - Landbased facilities only


LANDBASED FACILITIES
FRESHWATER
SEAWATER
FRESHWATER
ROE
STARTFEEDING
180 - 1.800 g
1.8 - 10 kg
STRIPPING
Founders
Yearclass 1
Yearclass 2
Yearclass 3
Yearclass 4
Yearclass 5
Yearclass 6





- All PMCV sequenced from the brood stock facilities cluster together
- Yearclasses cluster together
- Yearclass 6 shares most recent common ancestor with Yearclass 2 (the last positive stripping)

Is elimination of PMCV in brood stock maintained under closed containment achievable?

- Maybe…
- Yearclass 3, 4 and possibly 5 100% negative at stripping
- PMCV has been present somewhere in the system/fish
  - Operational data
  - Breeding program – CMS QTL
  - PMCV escapee
- Have managed to eliminate PMCV in Faroese aquaculture before – unintentionally
- Biosecurity
  - Roe disinfection

Thank you for your attention

PMCV-FoNET

National Reference Laboratory

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RESEARCH COUNCIL FAROE ISLANDS

FØROYAGRUNNURIN

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