Risk of disease transfer with wellboats in Norway

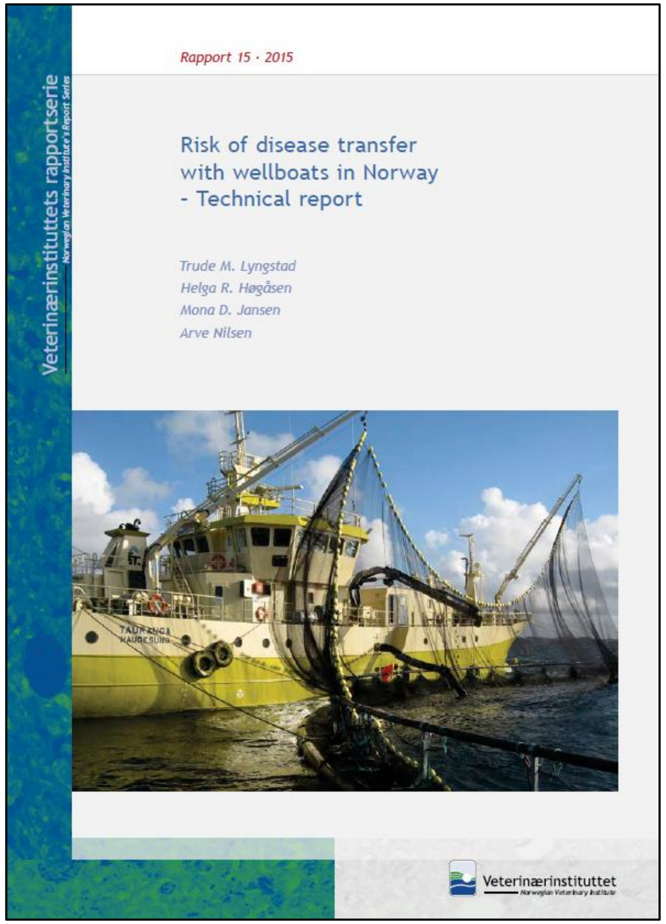
Mona Dverdal Jansen
Norwegian Veterinary Institute
AquaNor seminar, 19.08.2019

Wellboats are an essential part of the industry!

Photo: Arve Nilsen, NVI

Potential pathways for spread

- (Infected fish)
- Water
  - Transport water
  - Ballast water
  - Process water (for cleaning)
  - “Dead volume” spaces
- Biofilm
- Hull contamination



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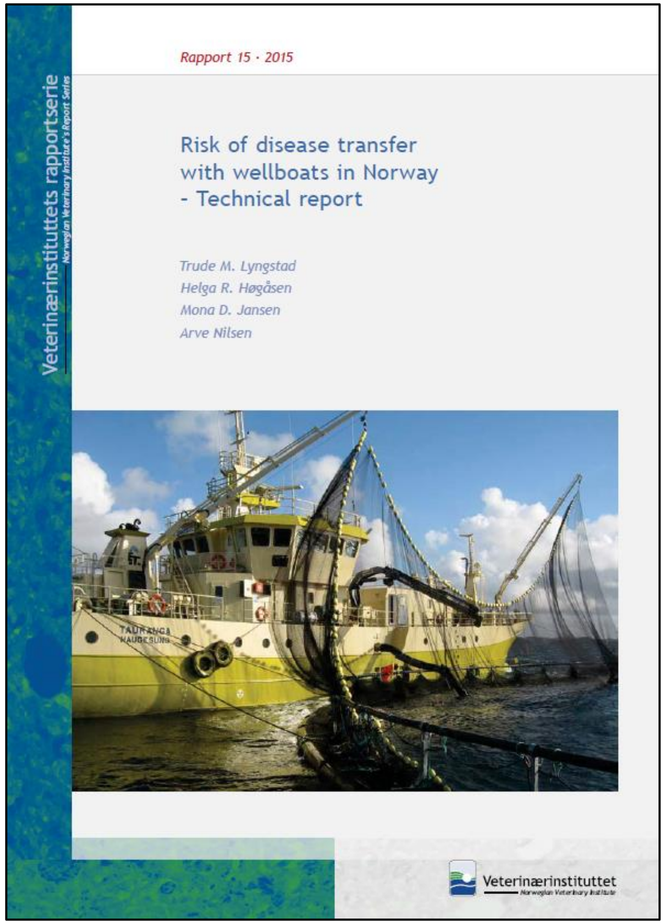
Major limitations

- No quantification of the risk
- Lack of data under field conditions
  - Pathogen survival
  - Minimum infectious dose
  - Washing & disinfection efficacy



Included in a broader context

"The increased and intensified official supervision of fish farms, wellboats, transport procedures, slaughterhouses, etc., ….. have been important factors in the control of the disease." (ISA)

Rev. sci. tech. Off. int. Epiz., 1999, 18 (1), 214-227

Successful aquatic animal disease emergency programmes

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Summary
The authors provide examples of emergency programmes which have been successful in eradicating or controlling certain diseases of aquatic animals. The paper is divided into four parts.
The first part describes the initial isolation of viral haemorrhagic septicaemia (VHS) virus in North America in the autumn of 1988 from feral adult chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) returning for

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Epidemiological studies unable to conclude

- ISA risk higher with multiple smolt sources, particularly if from hatcheries outside own county

"... may be explained by the spread of ISA during transportation, for example due to the transport vehicles used, than by a possible undiagnosed latent ISA in the smolt."

Vol. 28: 79–86, 1997 | DISEASES OF AQUATIC ORGANISMS Dis Aquat Org | Published February 13

Infectious salmon anaemia (ISA) risk factors in sea-cultured Atlantic salmon *Salmo salar*

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ABSTRACT: A matched case-control study of infectious salmon anaemia (ISA) risk factors in Norwegian salmonid sea sites was performed in 1993. The distribution of potential exposure factors associated with the site management and location was compared in 2 paired groups of sea sites, one group com-

Suspicions rarely confirmed (or disproved)

“Possible introduction routes may be through transport of infected smolt, insufficient disinfection of wellboats, or transmission from a marine reservoir.”

Journal of Fish Diseases 2013, **36**, 71–74 doi:10.1111/j.1365-2761.2012.01445.x

Short Communication

The first detections of subtype 2-related salmonid alphavirus (SAV2) in Atlantic salmon, *Salmo salar* L., in Norway

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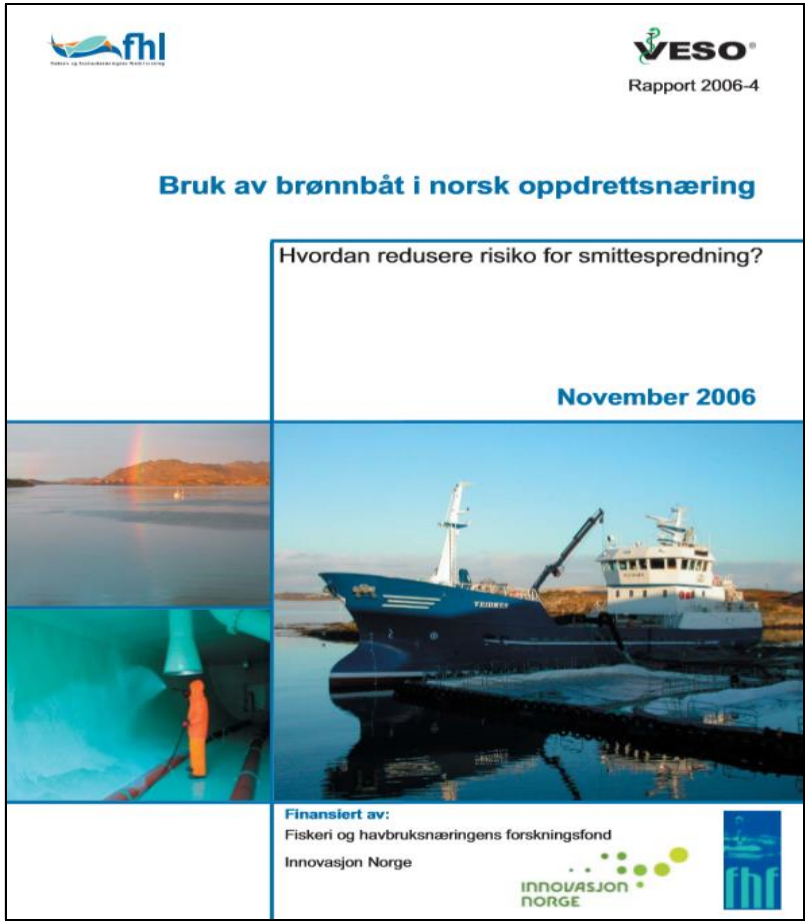
Norwegian Veterinary Institute, Oslo, Norway

Suspicions rarely confirmed (or disproved)

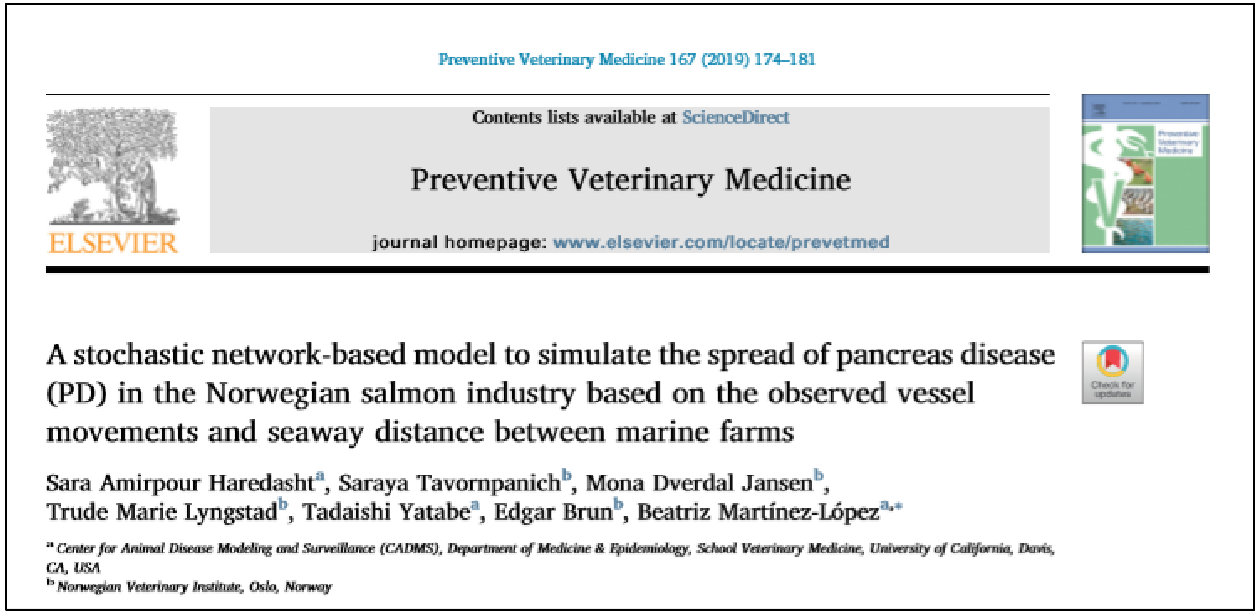
- Furunculosis to northern Norway
  - Wellboat? Previous transport = slaughter transport of furunculosis infected fish
- ISA spread
  - Wellboat? Previous transfer = ISAV infected fish; ISAV isolates identical
- SAV spread to northern Norway
  - Fish, transport water, wellboat?



Norwegian network-based simulation study

Aims:

- Use a network-based disease spread model (AIS data)
- Improve our understanding of SAV transmission dynamics in Norwegian aquaculture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A stochastic network-based model to simulate the spread of pancreas disease (PD) in the Norwegian salmon industry based on the observed vessel movements and seaway distance between marine farms

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Dataset

- Sea sites
  - GPS coordinates
  - Weekly production status in 2016 (active/fallowed)
  - Date of SAV detection/PD diagnosis in 2016
- Shortest seaway distance between sites
- Vessels
  - AIS data
  - Contact points (≤ 100-200m to a sea site)

Photo: Mari Press, NVI

Method

- Monthly networks between sea sites (Jan – Dec 2016)

  1. Observed vessel movements
  2. Seaway distance to other active sites

- Definition of “high risk-contact”

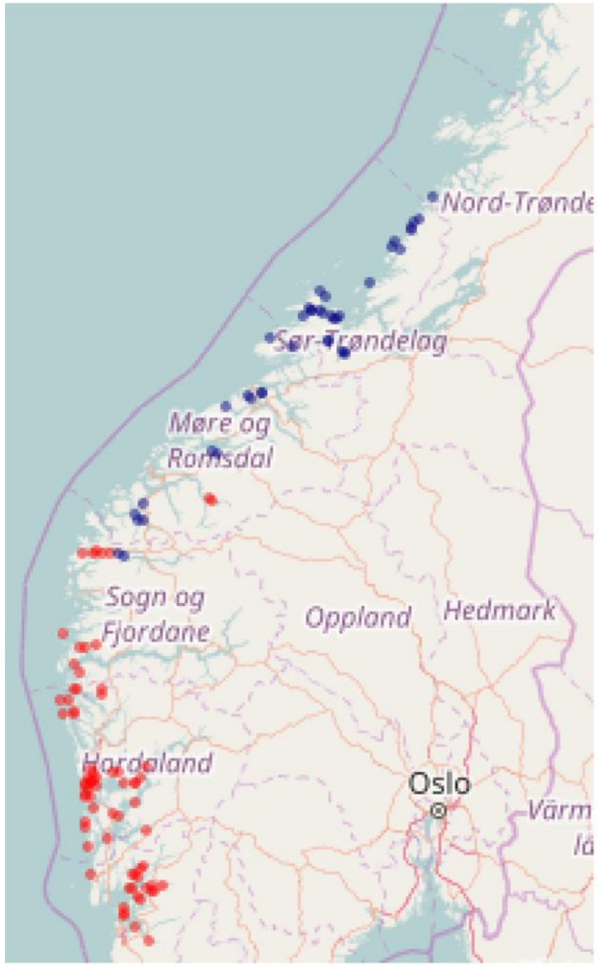
  a) Vessels: SAV +ve site to SAV ÷ve site within 7 days

  b) Seaway distance from SAV +ve site to SAV ÷ve site (<5, <10, <20 km)

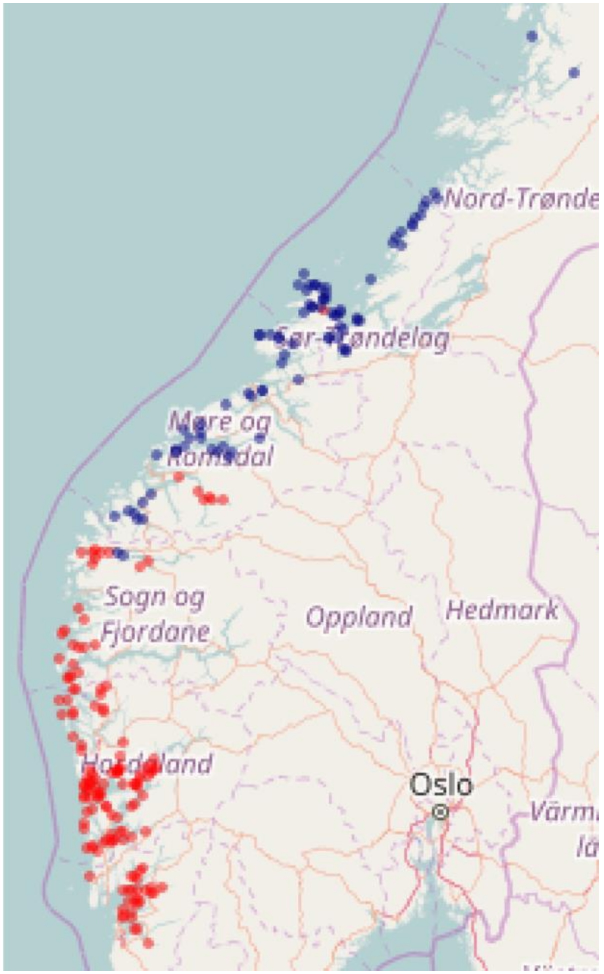
Results

- Index cases = 113 +ve sites
- Three models:
  a) PD - 231 SAV +ve sites
  b) SAV2 - 88 SAV2 +ve sites
  c) SAV3 – 144 SAV3 +ve sites

January 2016



December 2016



SAV2
SAV3

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Results

- Index cases = 113 +ve sites
- Three models:
  a) PD - 231 SAV +ve sites
  b) SAV2 - 88 SAV2 +ve sites
  c) SAV3 – 144 SAV3 +ve sites

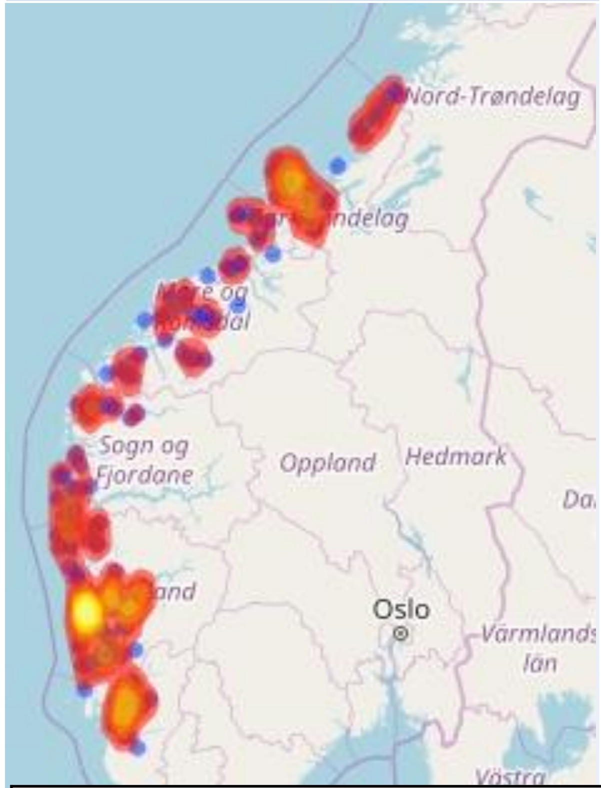
- Aquaculture-related vessel movements: 123 764
  a) High risk vessel:3 570 (2.88%)
  b) High risk wellboat: 478 (0.38%)

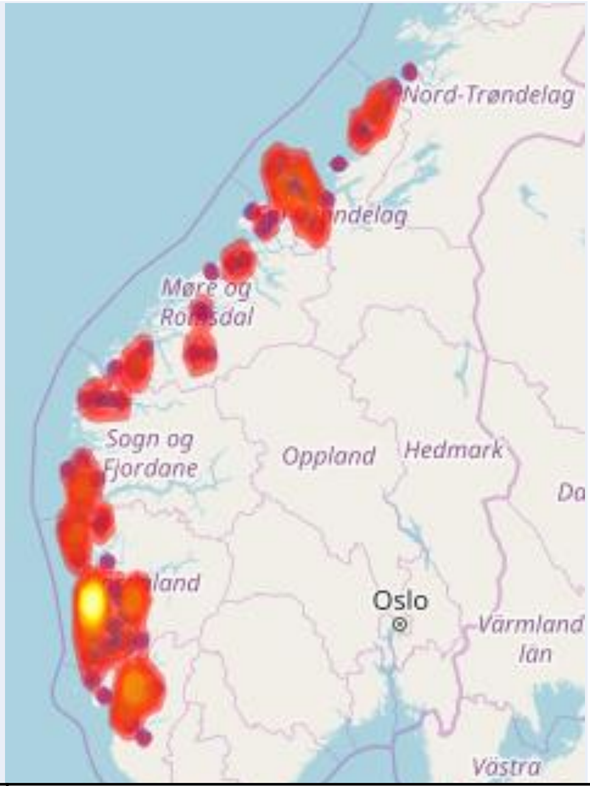
Proportion of correctly classified sites calculated

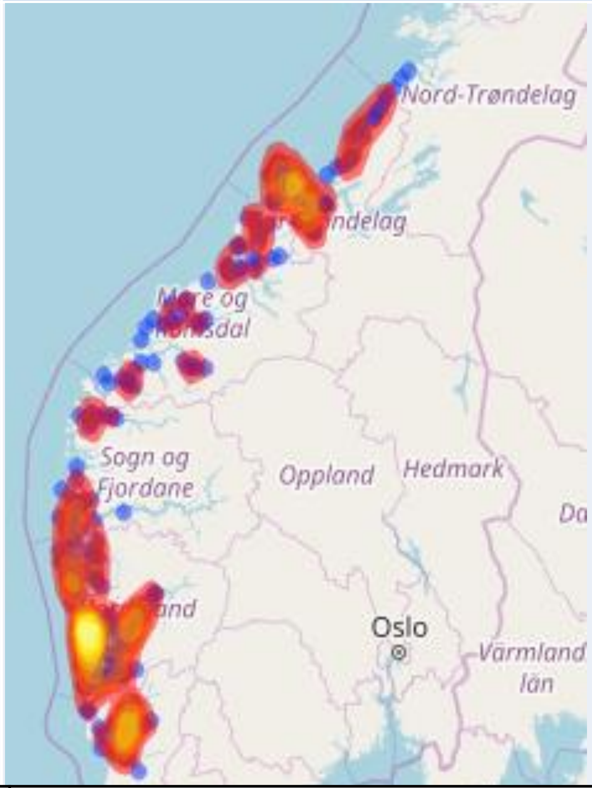
SAV +ve sites = sensitivity
SAV –ve sites = specificity

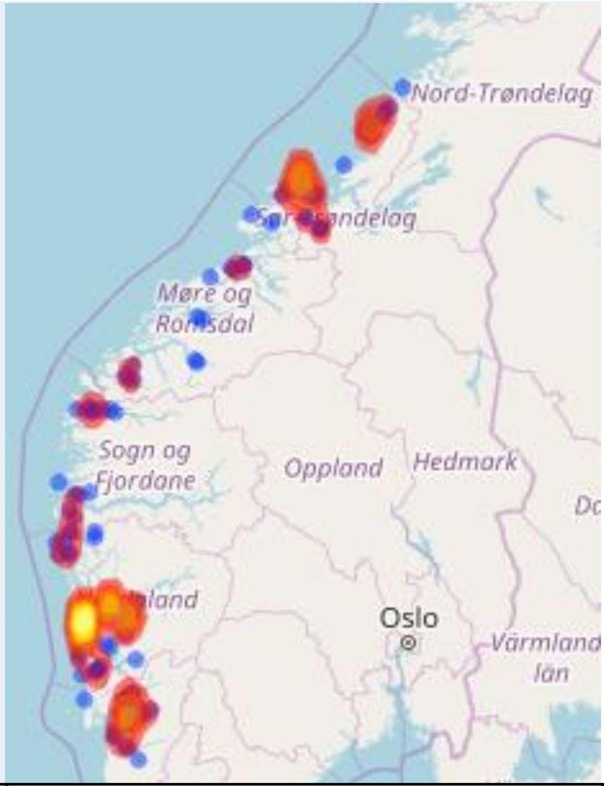
PD 2016 — Simulation results

	Wellboat movements	Boat movements	Seaway distance (<5km)





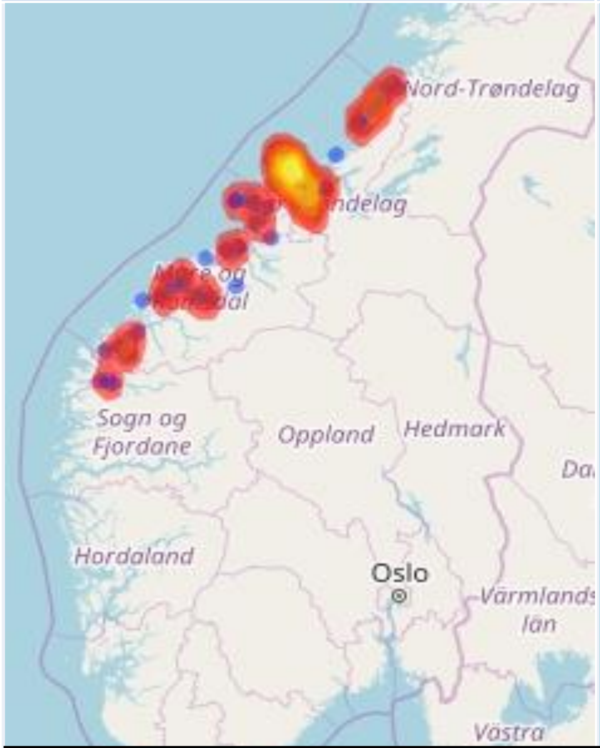


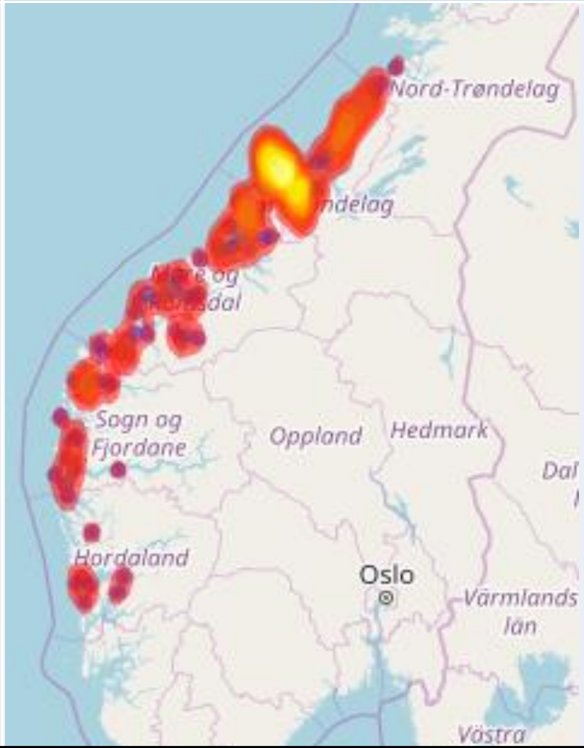


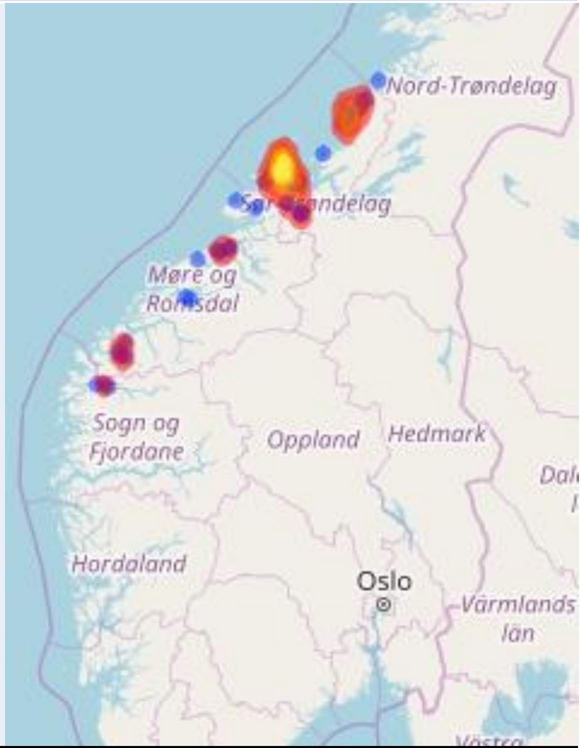
Sensitivity	0.84	0.82	0.45
Specificity	0.94	0.92	0.95

SAV2 2016 | Simulation results

	Wellboat movements	Boat movements	Seaway distance (<5km)



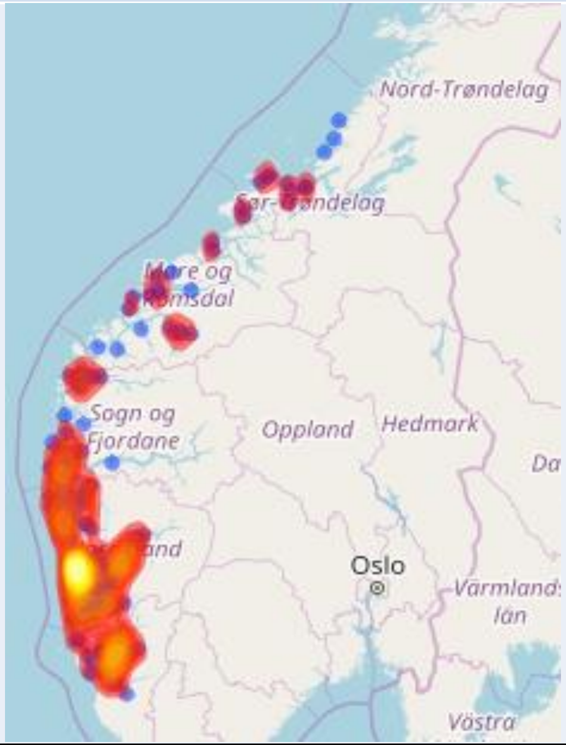




	Wellboat movements	Boat movements	Seaway distance (<5km)
Sensitivity	0.84	0.53	0.40
Specificity	0.98	0.99	0.99

SAV3 2016 — Simulation results

	Wellboat movements	Boat movements	Seaway distance (<5km)



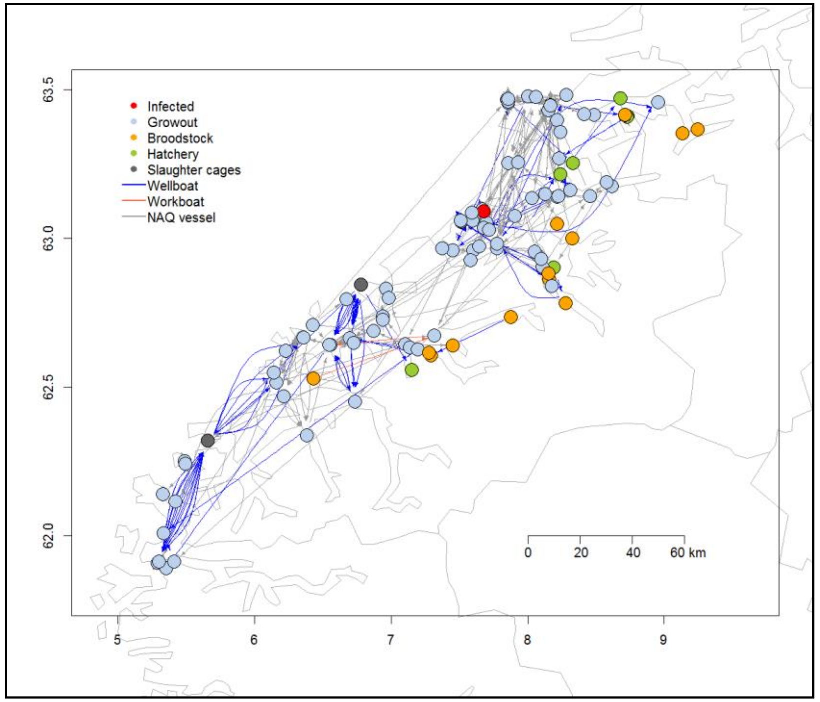
	Wellboat movements	Boat movements	Seaway distance (<5km)
Sensitivity	0.85	0.55	0.45
Specificity	0.97	0.99	0.98

Conclusions and limitations

- SAV-spread simulated with high sensitivity and specificity based on AIS-recorded wellboat movements
- Contribution to risk-based management
- Major limitations:
  - Doesn't say anything about how wellboat activity contributes to SAV spread
  - Monthly time steps
  - Lacked current screening-program data quality
  - Lacked input on e.g. hydrodynamics, vessel activities, site & vessel biosecurity, ownership

How to reduce future transmission risk?

- Restricted activities?
- Restricted geographical coverage?
- Improved biosecurity measures?
- Improved technology?



Wellboats are an essential part of the industry!

Need to determine how the risk may be mitigated and how this can be achieved in practice

Photo: Arve Nilsen, NVI

Photo: Colourbox