

# Effect of pancreas disease vaccines on infection levels in Atlantic salmon challenged with salmonid alphavirus, genotype 2

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<sup>2</sup> VESO Aqualab, Norway

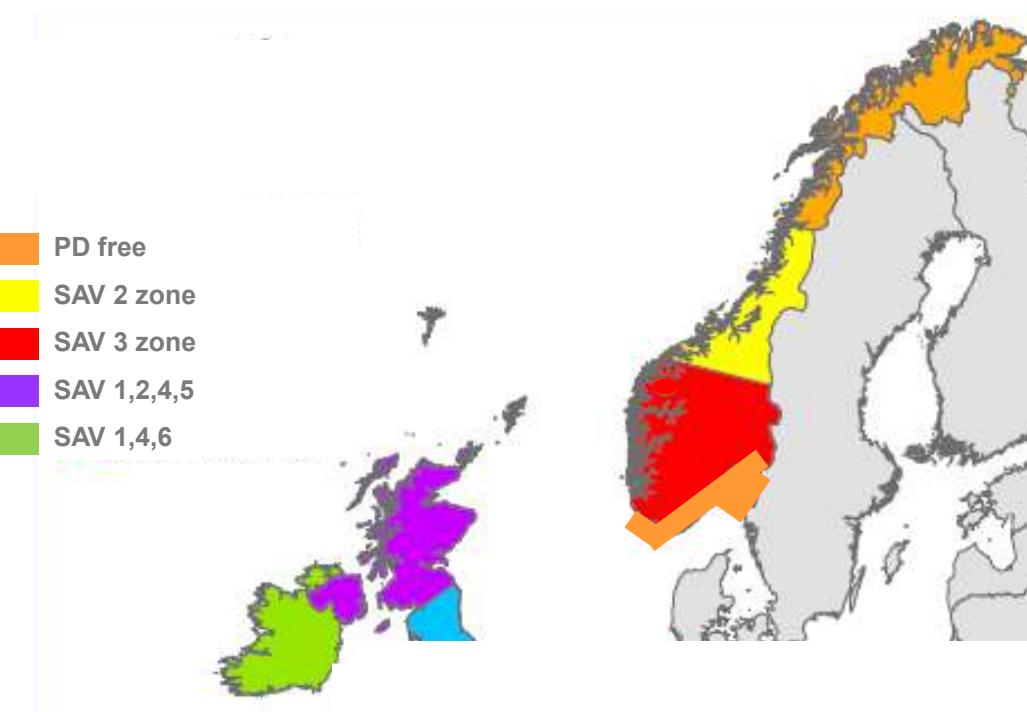
<sup>3</sup> Experimental Pathology Laboratories Inc., USA

<sup>3</sup> Norwegian Veterinary Institute, Ås, Norway

<sup>4</sup> Norwegian University of Life Sciences, Oslo, Norway

# Background

*Distribution of SAV genotypes in European salmon farming\**

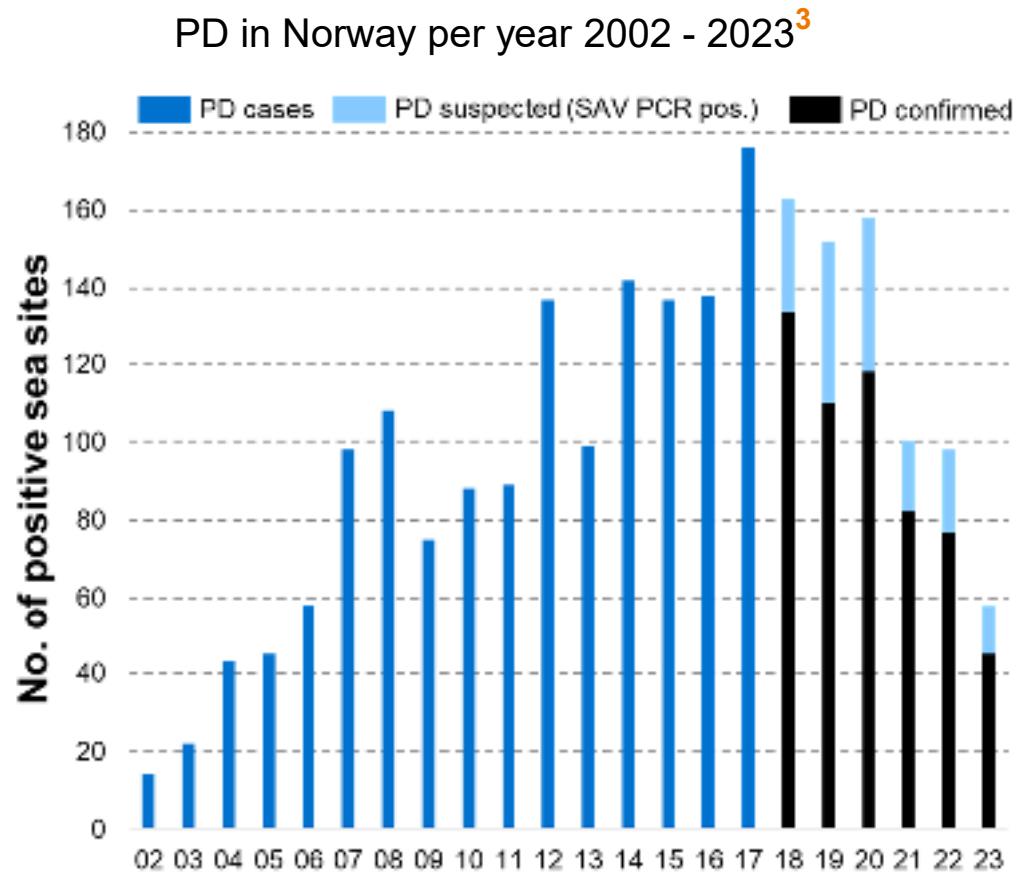


\*

Jansen, M.D. et al. 2017. The epidemiology of pancreas disease in salmonid aquaculture: a summary of the current state of knowledge, Journal of Fish Diseases 40(1), 141-155.

## Background cont...

- PD was the most costly clinical disease for Norwegian salmon farming for many years<sup>1</sup>
- Reduced growth and increased FCR are the biggest cost variables of PD<sup>1, 2</sup>
- Marked reduction in number of suspected and confirmed PD cases in recent years<sup>3</sup>



<sup>1</sup> Pettersen, J.M. et al., 2015. The economic benefits of disease triggered early harvest: A case study of pancreas disease in farmed Atlantic salmon from Norway. Preventive veterinary medicine. 121, 314-324.

<sup>2</sup> Rødsæg, M.V. et al., 2021. Effect of vaccines against pancreas disease in farmed Atlantic salmon. Journal of Fish Diseases. 44, 1911-1924

<sup>3</sup> <https://www.vetinst.no/dyr/oppdrettsfisk/pankreasssykdom-pd-utbrudd-og-statistikk>

# Study objective

To evaluate the relative efficacy of the vaccination strategies against PD commonly used in mid-Norway (SAV2 zone)

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**Effect of pancreas disease vaccines on infection levels and virus transmission in Atlantic salmon (*Salmo salar*) challenged with salmonid alphavirus, genotype 2**

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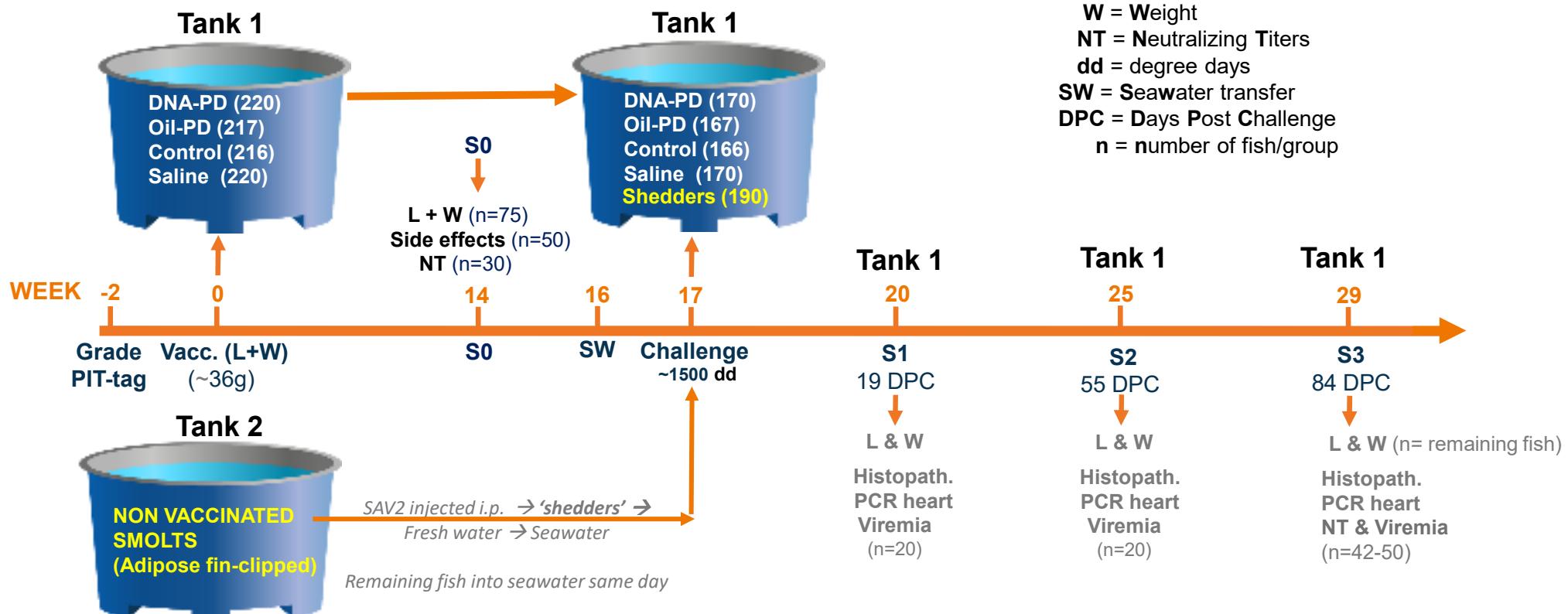
# Treatment groups

Group ID	PD vaccine Clynav (i.m. – 0.05 ml)	PD vaccine AJm-1PD (i.p. – 0.05 ml)	6-comp. vaccine AJm-6 (i.p. – 0.05 ml)	ERM vaccine Alpha ERM Salar (i.p. – 0.025 ml)	Saline (i.p. – 0.05 ml)
DNA-PD	✓		✓	✓	
Oil-PD		✓	✓	✓	
Control			✓	✓	
Saline					✓

i.m. – injected intramuscularly  
i.p. – injected intraperitoneally

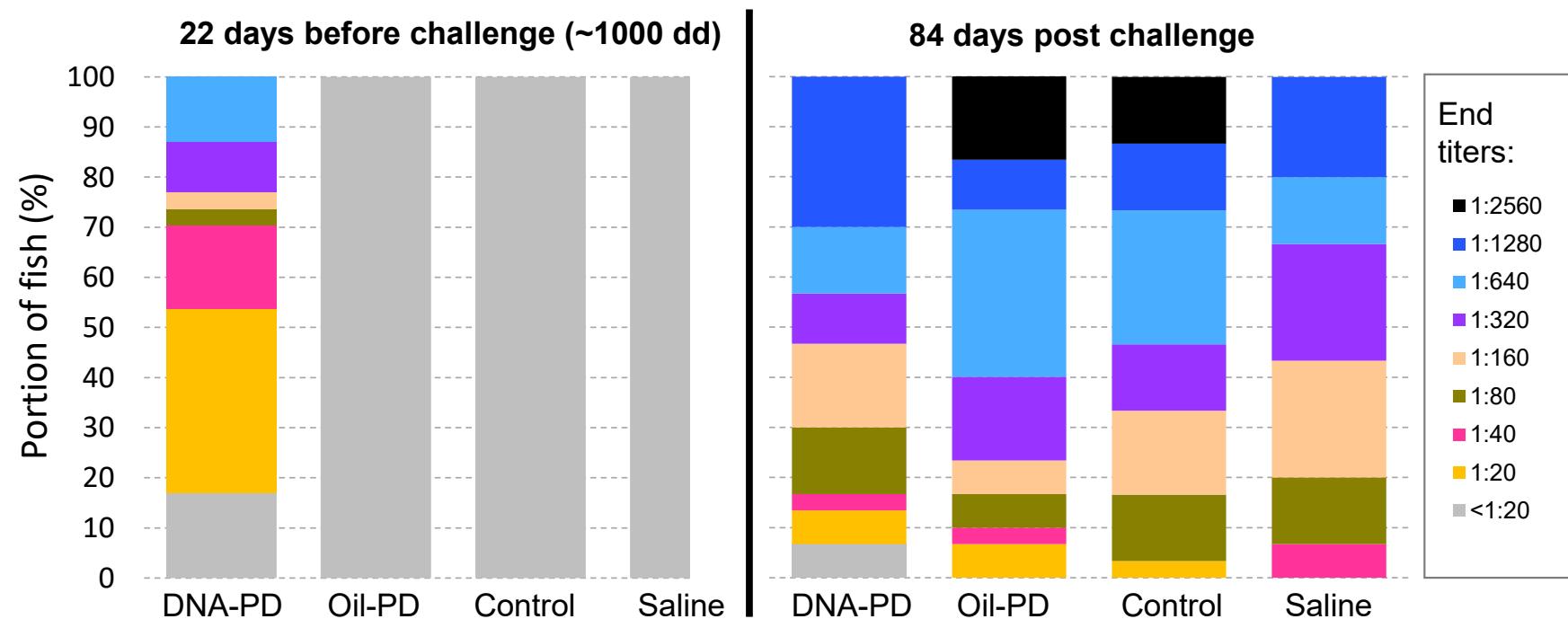
# Experimental outline

Fish held at 12-13°C



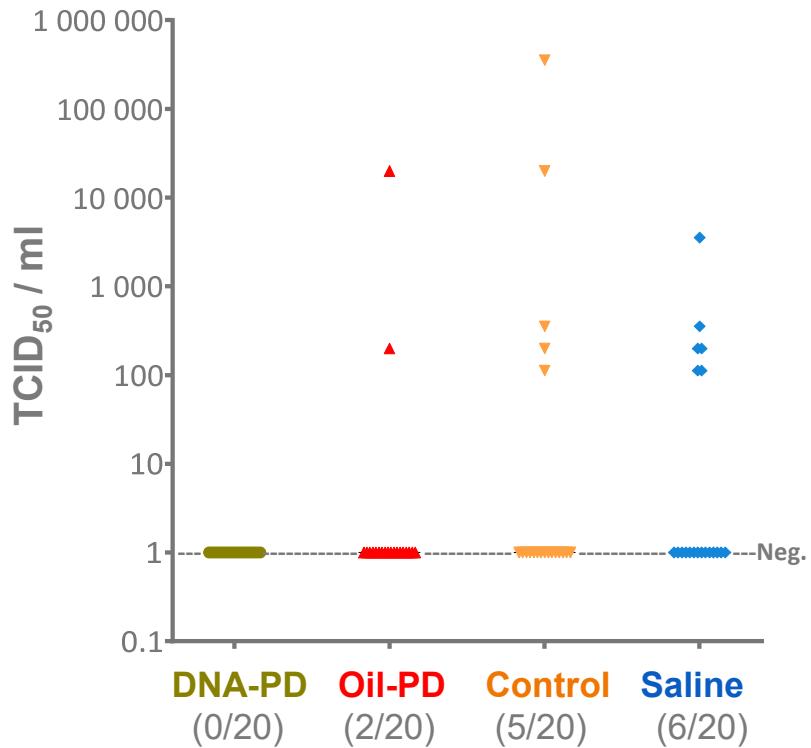
# SAV2 neutralization end titers<sup>1</sup> prior to & at end of challenge

~1000 degree days post vaccination (n=30 fish per group)



<sup>1</sup> Graham, D. et al. 2003. A rapid immunoperoxidase-based virus neutralization assay for salmonid alphavirus used for serological survey in Northern Ireland. Journal of fish diseases. 26. 407-13.

## SAV2 in plasma<sup>1</sup> (viremia) 19 dpc (n=20)



<sup>1</sup> Jewhurst, V A, et al, 2004. Detection and antigenic characterization of salmonid alphavirus isolates from sera obtained from farmed Atlantic salmon, *Salmo salar* L., and farmed rainbow trout, *Oncorhynchus mykiss* (Walbaum). Journal of fish diseases. 27. 143-9.

# Histopathology – interim data

- Specimens randomized and coded, then evaluated without knowledge of exposure group ('blinded')
- Standardized severity grading for each diagnostic criteria and tissue as previously described<sup>1, 2</sup>
- Tissues and diagnosis criteria 55 and 84 DPC marked bold ("X") will be presented:

Diagnostic criteria for each tissue type

	Heart	Pancreas	Red muscle	White muscle
Necrosis	X	X	X	X
Inflammation	X	X	X	X
Regeneration	X		X	X
Fibrosis		X	X	X
Tissue loss		X		

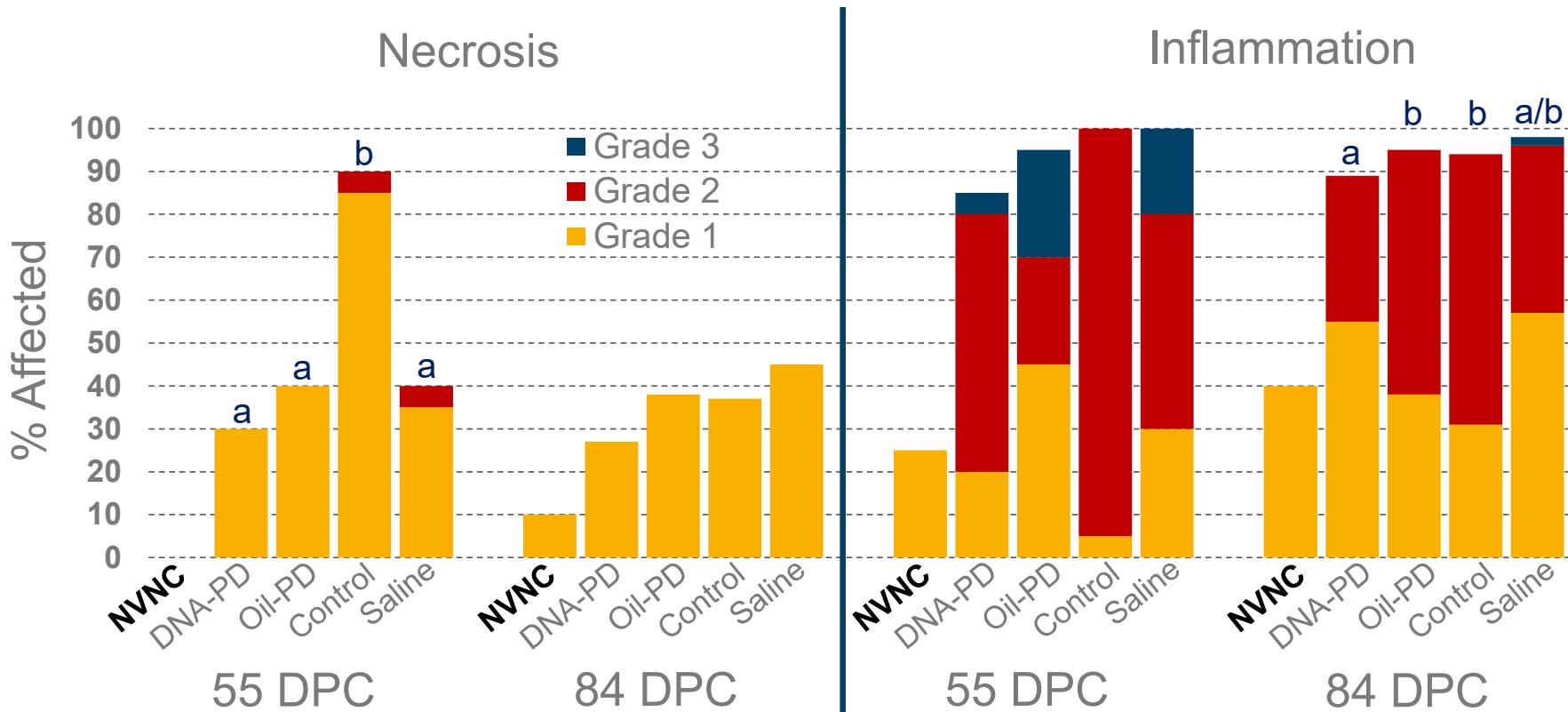
Standardized severity grading for diagnostic criteria

Grade 0	Not remarkable
Grade 1	Mild
Grade 2	Moderate
Grade 3	Severe

<sup>1</sup> Thorarinsson, R et al, 2021. Effect of a novel DNA vaccine against pancreas disease caused by salmonid alphavirus subtype 3 in Atlantic salmon (*Salmo salar*). Fish & Shellfish Immunology, 108, 116–126.

<sup>2</sup> Thorarinsson, R et al, 2022. Effect of a DNA and multivalent oil-adjuvanted vaccines against pancreas disease in Atlantic salmon (*Salmo salar*) challenged with salmonid alphavirus subtype 3. Fish & Shellfish Immunology Reports, 3, 100063.

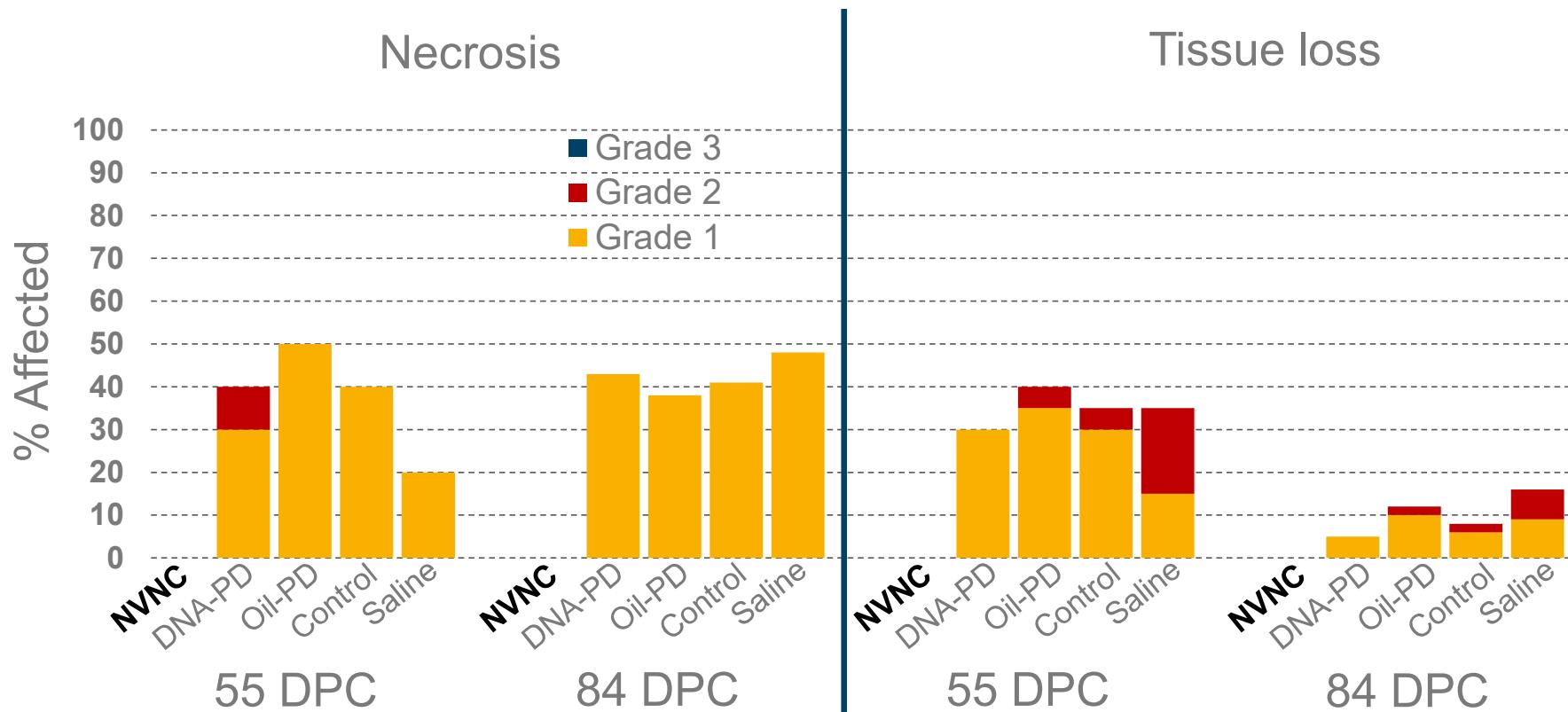
# Heart necrosis and inflammation 55 (n=20) and 84 DPC (n=42-49)



**NVNC** = Non Vaccinated Non Challenged (n=10)

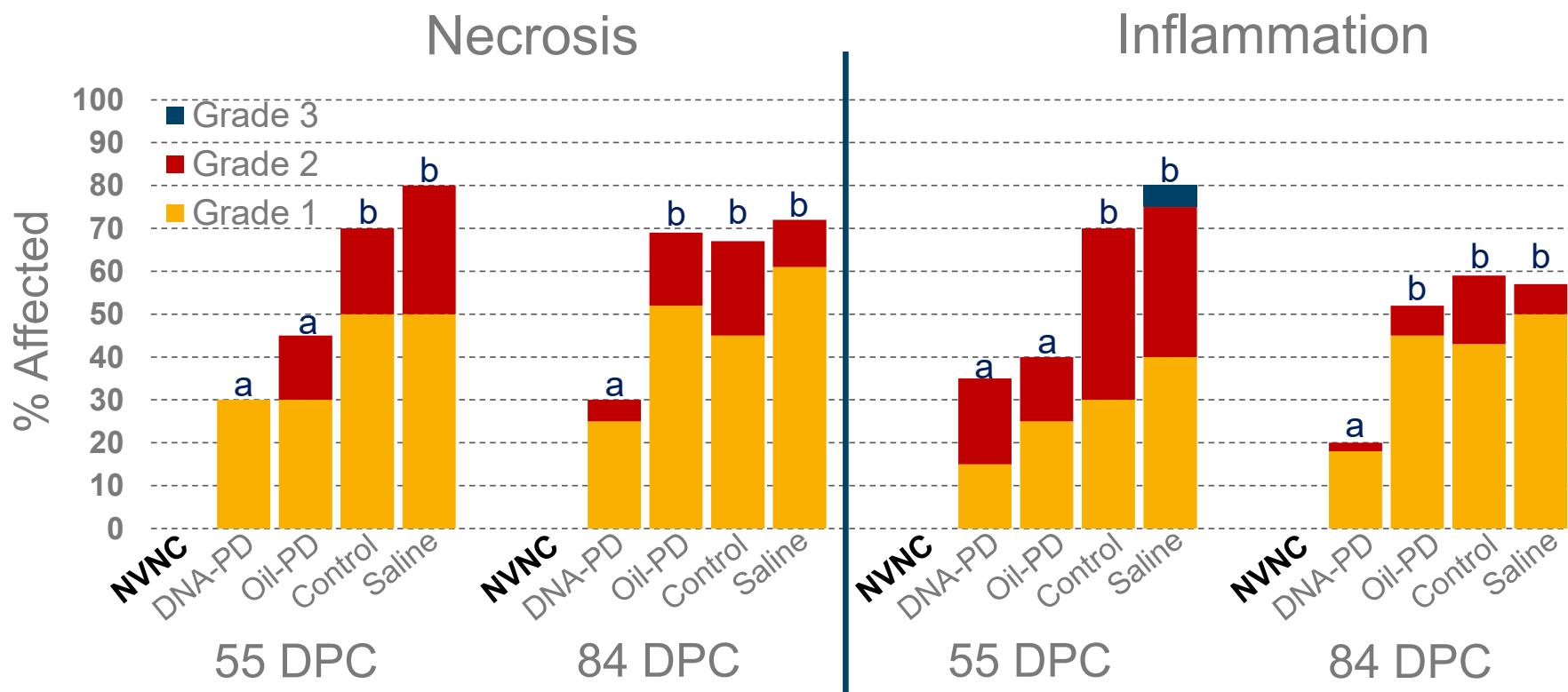
Different letters (a, b) denote significant differences (Ordinal logistic regression  $p<0.001$ ).

## Pancreas necrosis and tissue loss 55 (n=20) and 84 DPC (n=42-49)



**NVNC** = Non Vaccinated Non Challenged (n=10)

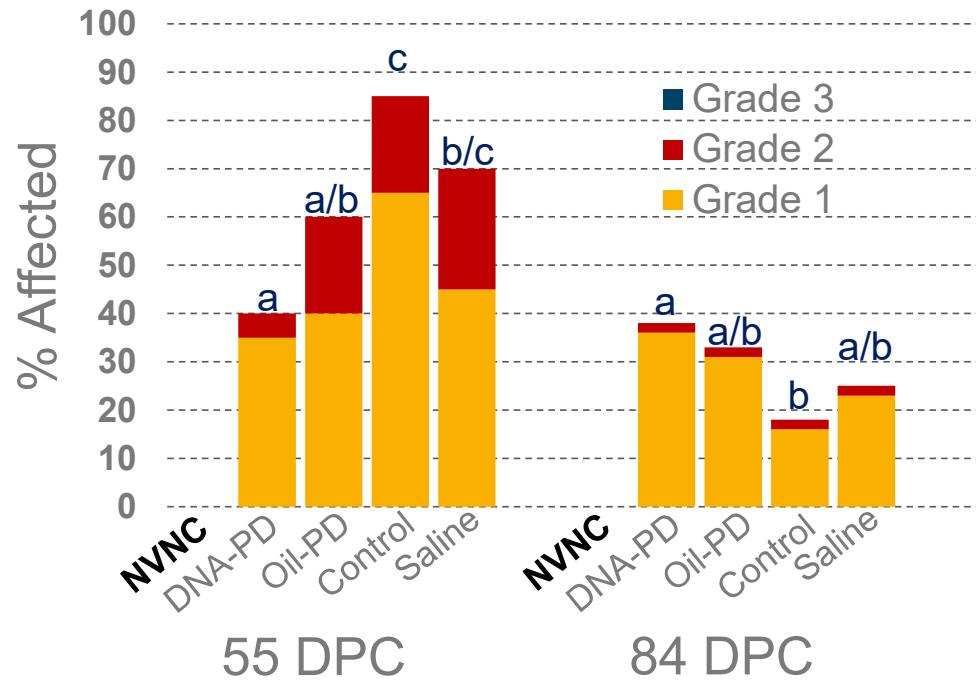
## Red muscle necrosis and inflammation 55 (n=20) and 84 DPC (n=42-49)



**NVNC** = Non Vaccinated Non Challenged (n=10)

Different letters (a, b) denote significant differences (Ordinal logistic regression  $p<0.04$ ).

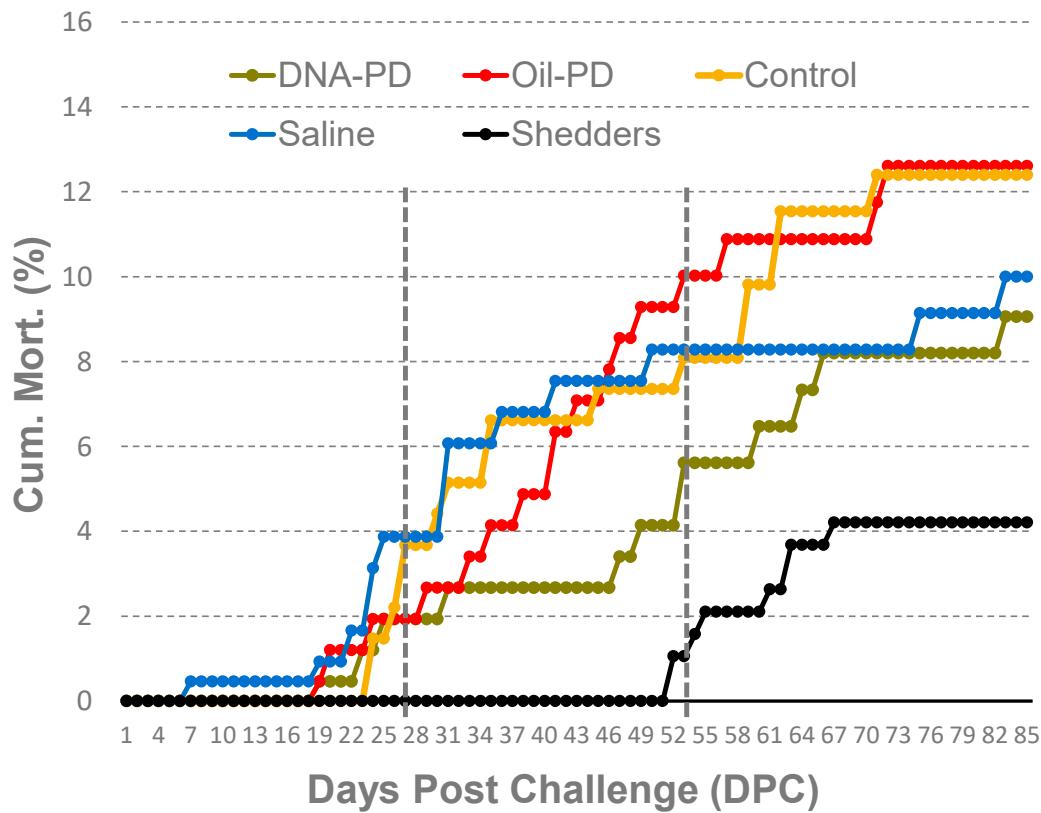
## White muscle necrosis 55 (n=20) and 84 DPC (n=42-49)



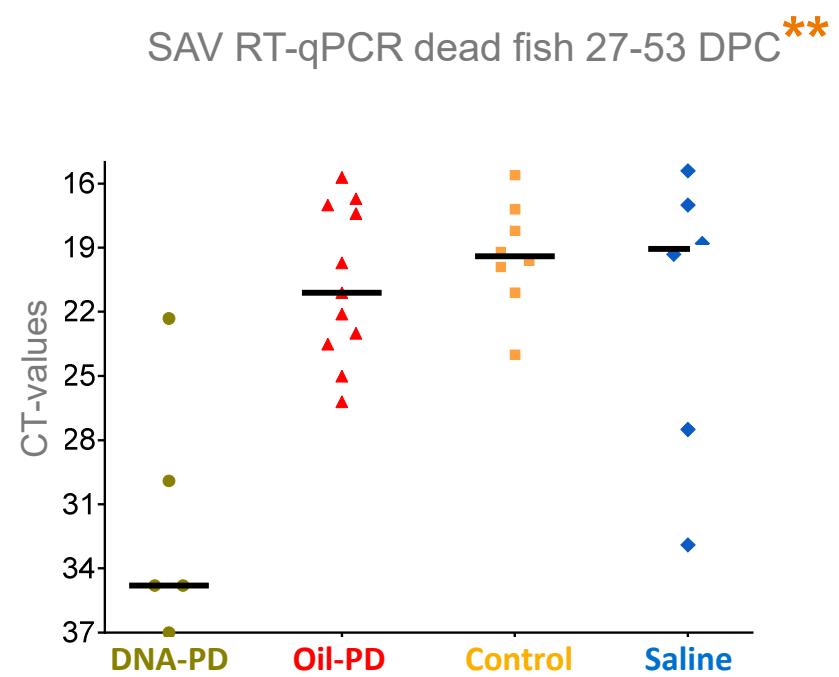
**NVNC** = Non Vaccinated Non Challenged (n=10)

Different letters (a, b, c) denote significant differences (Ordinal logistic regression  $p<0.04$ ).

# Cumulative mortality\*



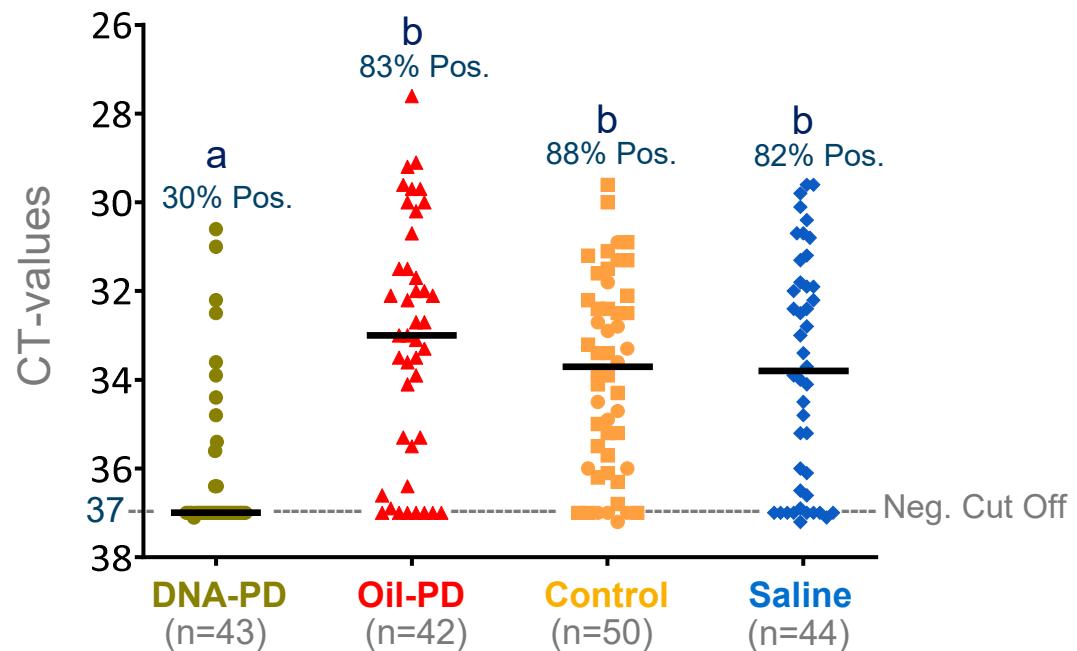
\* Denominator adjusted in the calculation after each sampling



\*\* Carried out by Patogen AS, Ålesund, Norway

## SAV2 infection levels at study termination 84 DPC\*

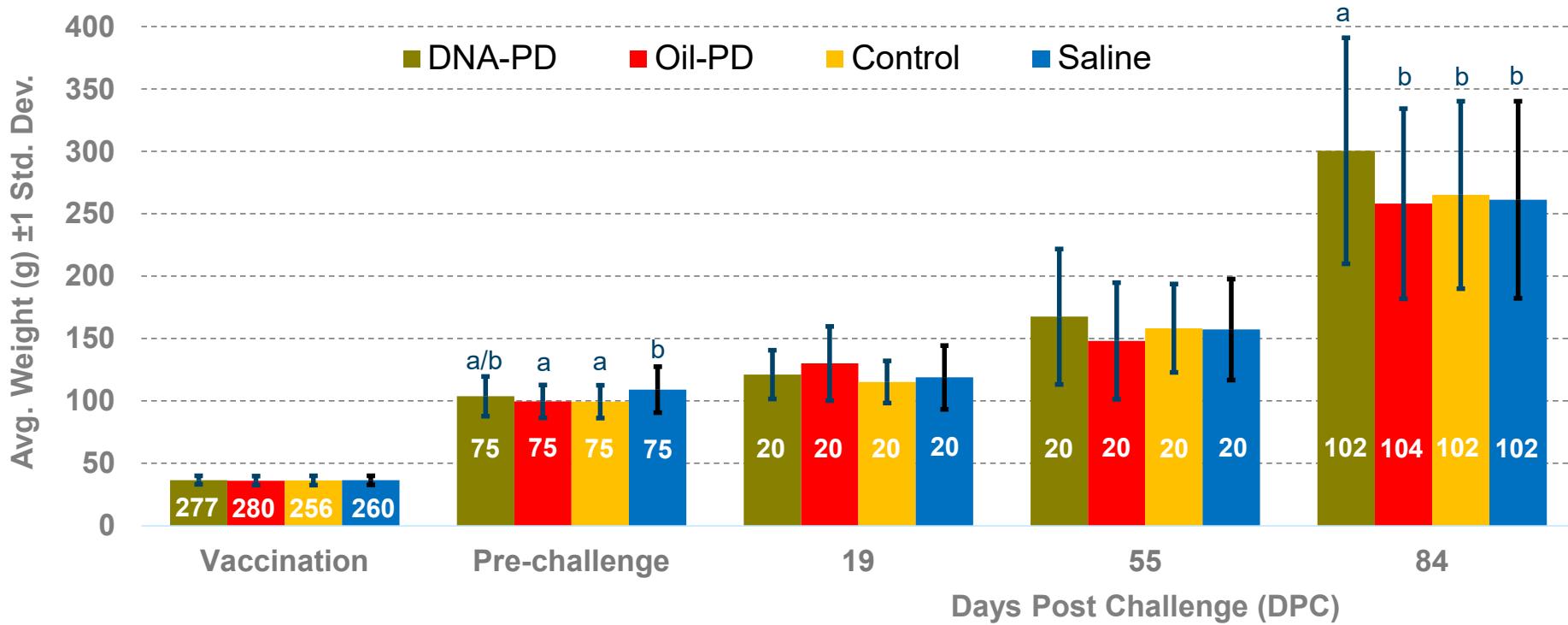
All groups had high and similar prevalence ( $\geq 90\%$ ) of PCR positive at 55 DPC (data not shown)



Different letters (a, b) denote significant differences (Median regression analysis  $p<0.001$ ).

\*Carried out by Patogen AS, Ålesund, Norway

# Growth prior to and after SAV2 challenge



Number inside each bar represents no. of fish (n).

Different letters (a, b) denote significant differences (Linear regression analysis  $p<0.015$ ).

# Conclusions

IMMUNE RESPONSE	INFECTION	PROTECTION
DNA-PD group had high prevalence (83%) of neutralizing antibodies with end titers from 1:20 to 1:640	Minimal viremia levels 19 DPC in all groups except the PD-DNA group	Mortality levels lowest in the DNA-PD group during most of the infection period
	Moderate to low levels of pancreas necrosis and tissue loss with no differences between the groups	DNA-PD group had significantly reduced SAV RNA levels (RT-qPCR) in the hearts at 84 DPC compared to the other groups
	In general, DNA-PD group had less cardiac and skeletal muscle necrosis & inflammation compared to the other groups	DNA-PD group had gained significantly more weight compared to the other groups at 84 DPC

# Conclusion cont....

*With exception of mortality levels, generally lower virulence of SAV2 compared earlier SAV3 studies*

## Current SAV2 study

2024

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free Full Research Article  
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## Earlier SAV3 studies

2021

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**Keywords:** DNA vaccine, Atlantic salmon, *Salmo salar*, pancreas disease, salmonid alphavirus, *Salmarubis*, *Salmarubis* subtype 3, *Salmarubis* genotype 2

**Full Length Article**

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# Thank you

*Forever Salmon*