PISCINE ORTHOREOVIRUS (PRV-3), a new pathogen for farmed Rainbow trout

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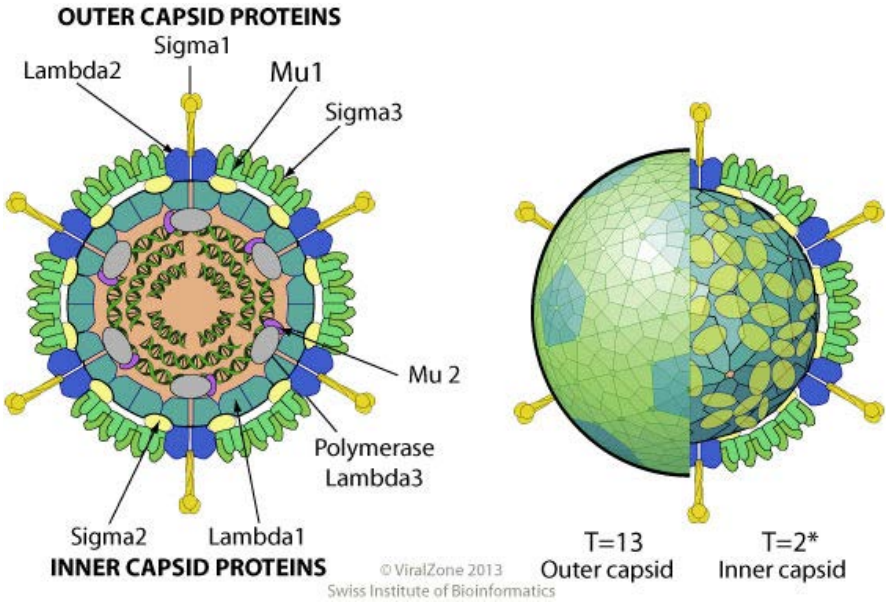
DTU Aqua
National Institute of Aquatic Resources

Piscine Orthoreovirus -PRV



- **dsRNA virus segmented non-enveloped RNA virus**
- **Belongs to the Reoviridae Family**
- **Contains 10 segments L1 for qPCR diagn S1 for sequencing**
- **Possible to cultivate ex vivo but no cell lines available!**

PRV or PRVs?

Proposal for nomenclature

PRV-1 – Atlantic salmon – HSMI (1999)

PRV-2 – mainly Onchorynchus (+ *S.salar*) – EIBS (1982)

PRV-3 – PRV-Om – Virus Y- Rainbow trout – heart pathology (2013)

Old stories, new protagonists

viruses

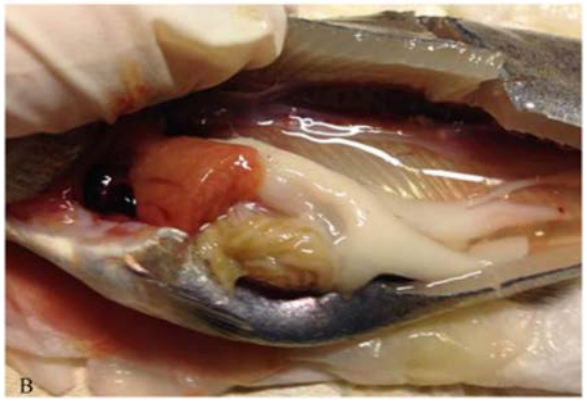
MDPI

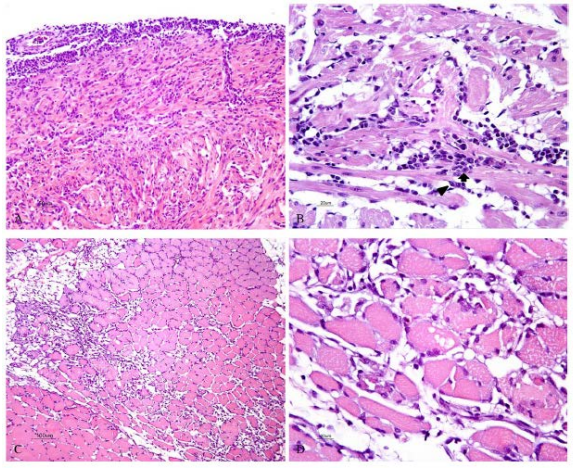
Article

Molecular and Antigenic Characterization of *Piscine orthoreovirus* (PRV) from Rainbow Trout (*Oncorhynchus mykiss*)

Kannimuthu Dhamotharan [1], Niccolò Vendramin [2], Turhan Markussen [1], Øystein Wessel [1], Argelia Cuenca [2], Ingvild B. Nyman [1], Anne Berit Olsen [3], Torstein Tengs [1], Maria Krudtaa Dahle [4] and Espen Rimstad [1,*]

PLOS ONE

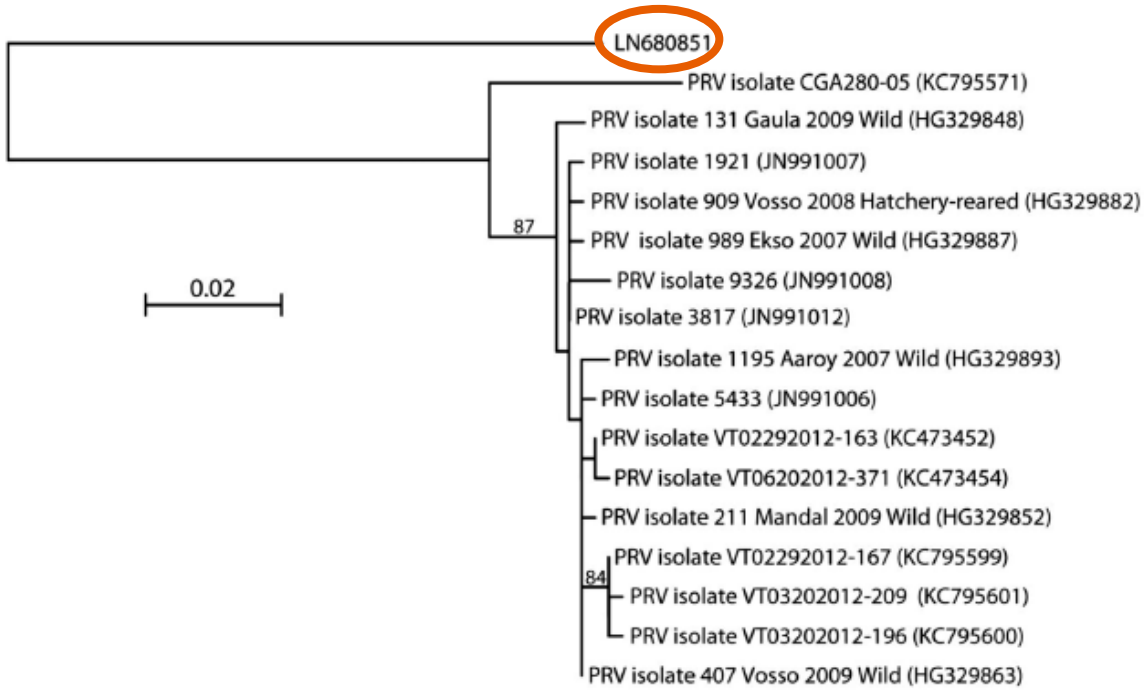




RESEARCH ARTICLE

First Description of a New Disease in Rainbow Trout (*Oncorhynchus mykiss* (Walbaum)) Similar to Heart and Skeletal Muscle Inflammation (HSMI) and Detection of a Gene Sequence Related to Piscine Orthoreovirus (PRV)

Anne Berit Olsen[1]*, Monika Hjortaas[2], Torstein Tengs[2], Hege Hellberg[1¤a], Renate Johansen[2¤b]



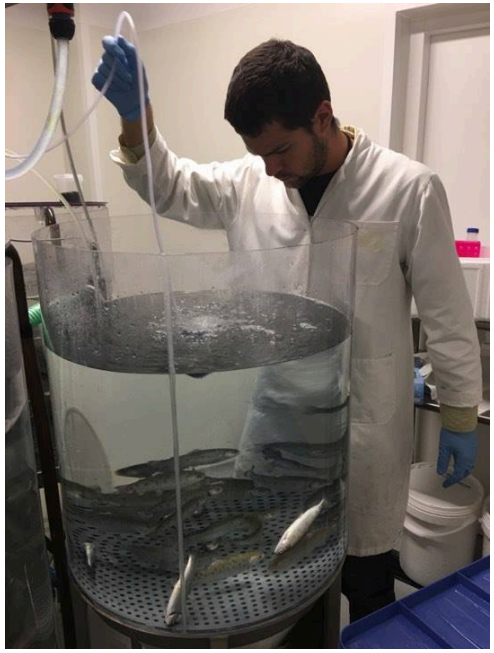
PLOS ONE

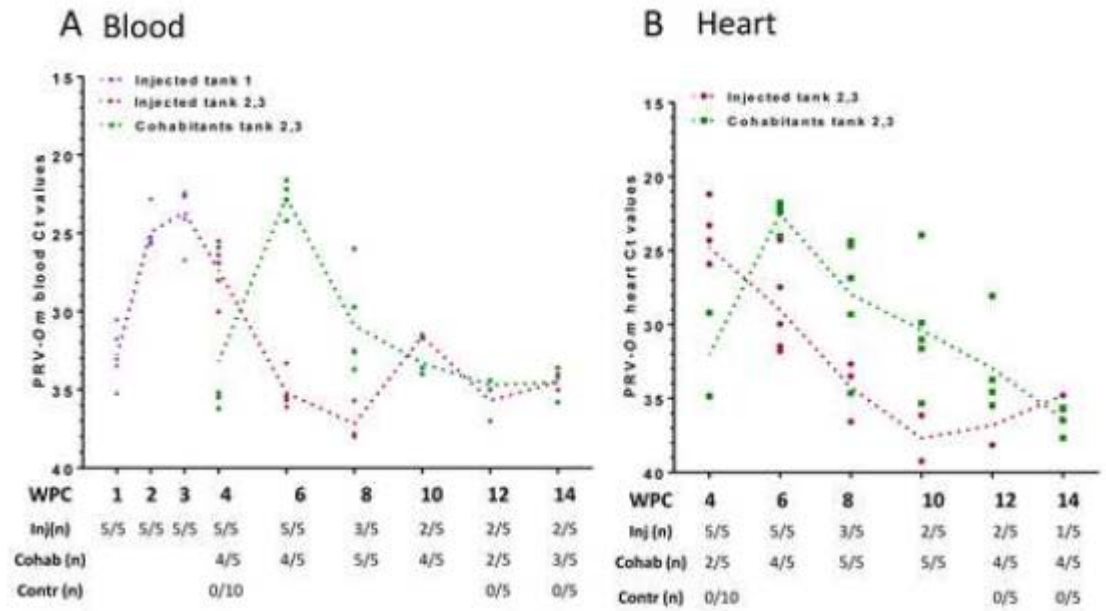
DTU

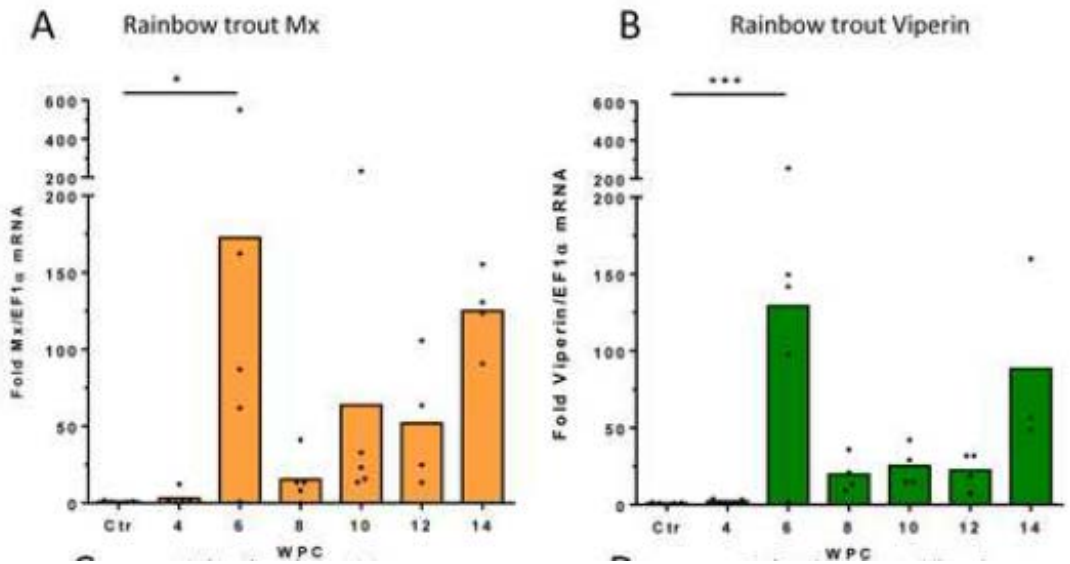
RESEARCH ARTICLE

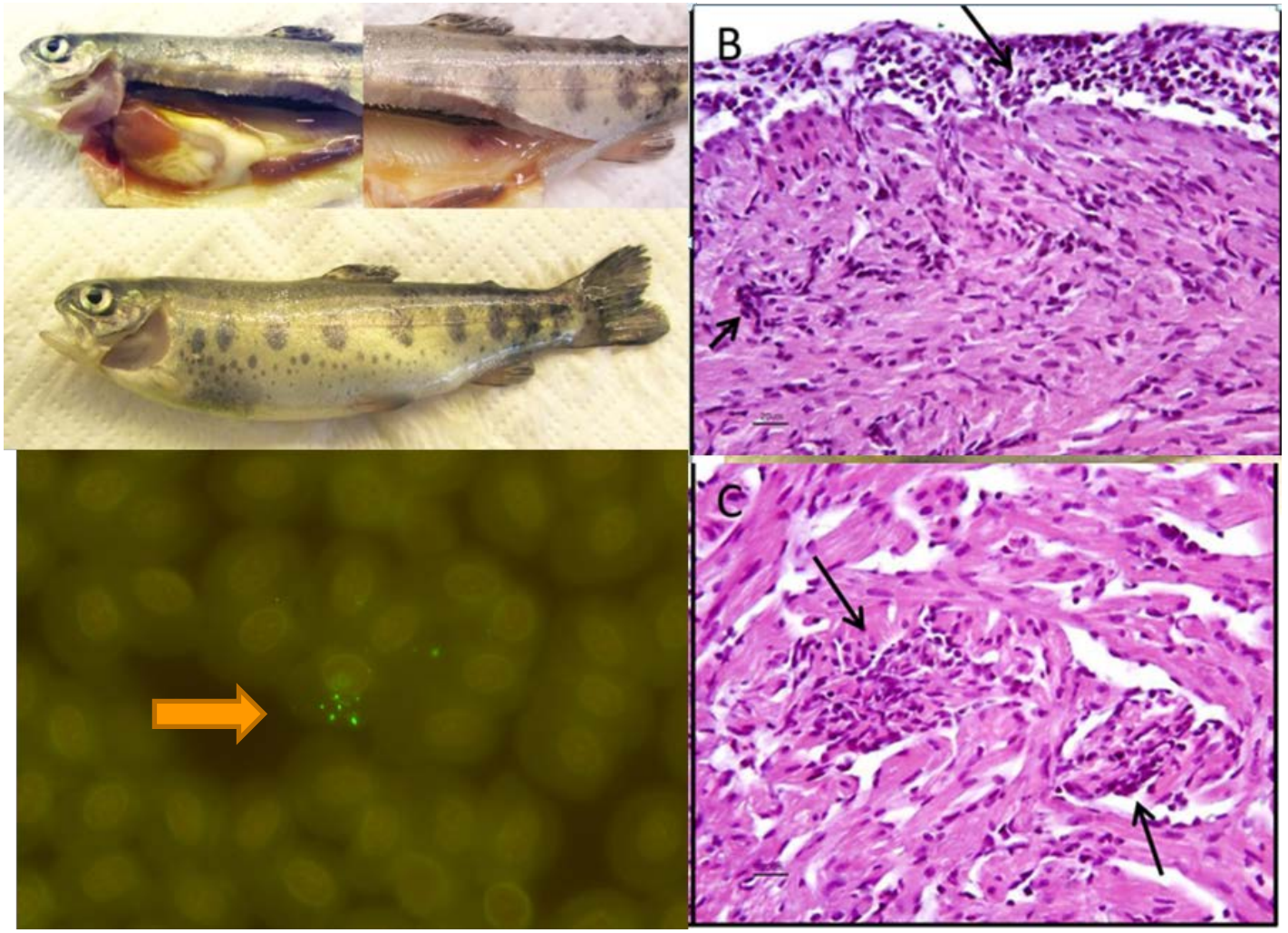
Infection experiments with novel *Piscine orthoreovirus* from rainbow trout (*Oncorhynchus mykiss*) in salmonids

Helena Hauge[1☯], Niccolo Vendramin[2☯], Torunn Taksdal[1], Anne Berit Olsen[1], Øystein Wessel[3], Susie Sommer Mikkelsen[2], Anna Luiza Farias Alencar[2], Niels Jørgen Olesen[2], Maria Krudtaa Dahle[1]*




A Blood
Injected tank 1
Injected tank 2,3
Cohabitants tank 2,3
PRV-Om blood Ct values
WPC 1 2 3 4 6 8 10 12 14
Inj(n) 5/5 5/5 5/5 5/5 5/5 3/5 2/5 2/5 2/5
Cohab (n) 4/5 4/5 5/5 4/5 2/5 3/5
Contr (n) 0/10 0/5 0/5
B Heart
Injected tank 2,3
Cohabitants tank 2,3
PRV-Om heart Ct values
WPC 4 6 8 10 12 14
Inj (n) 5/5 5/5 3/5 2/5 2/5 1/5
Cohab (n) 2/5 4/5 5/5 5/5 4/5 4/5
Contr (n) 0/10 0/5 0/5


A Rainbow trout Mx
Fold Mx/EF1α mRNA
Ctr 4 6 8 10 12 14
WPC
B Rainbow trout Viperin
Fold Viperin/EF1α mRNA
Ctr 4 6 8 10 12 14
WPC


B
C

PRV-3

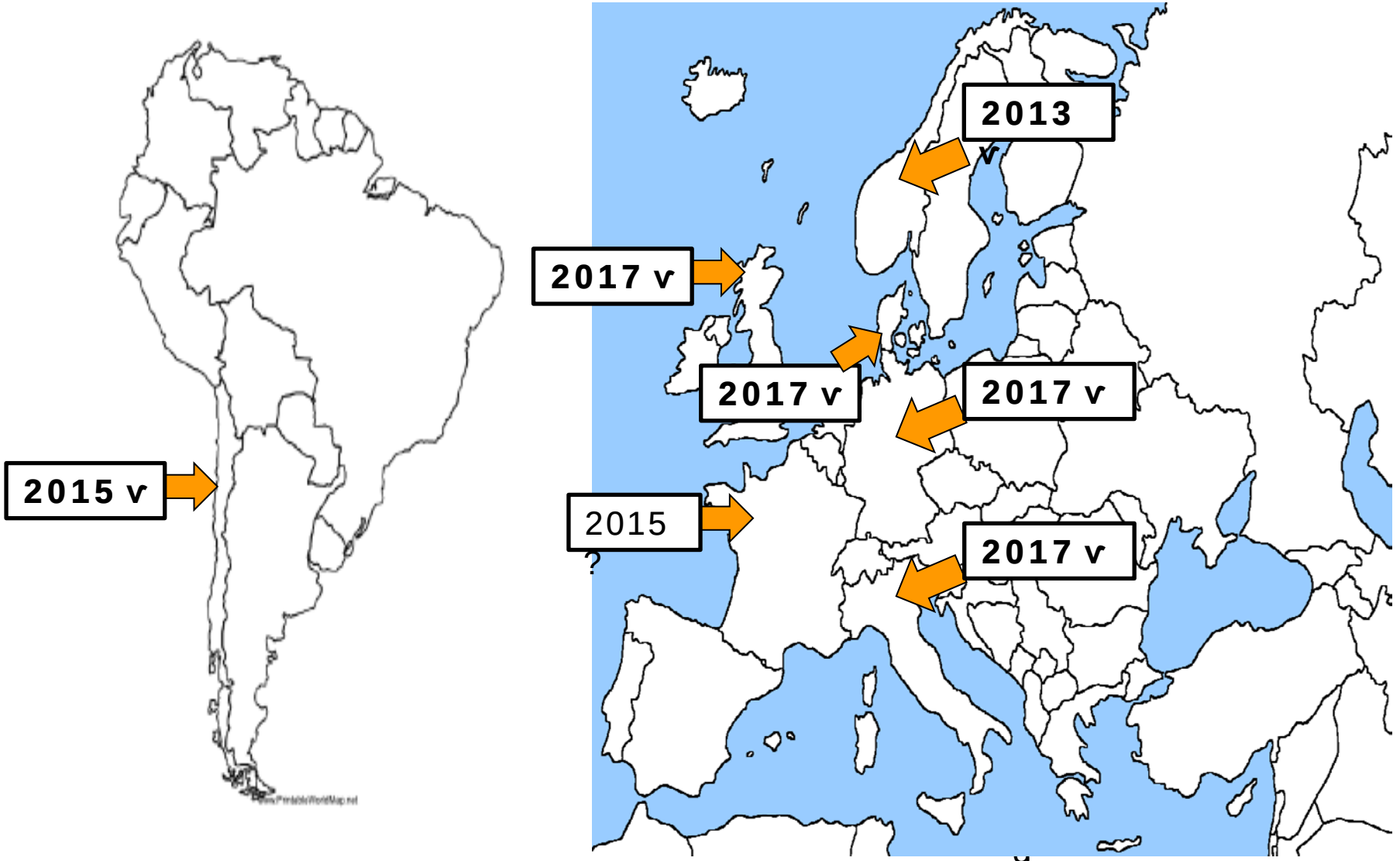
Rainbow trout

- Under experimental conditions is an acute infection which peaks and is cleared by the host
- Low (**very low**) reduced survival
- Infects red blood cells
- Causes heart pathology
- Induce iper expression of MX and Viperin genes

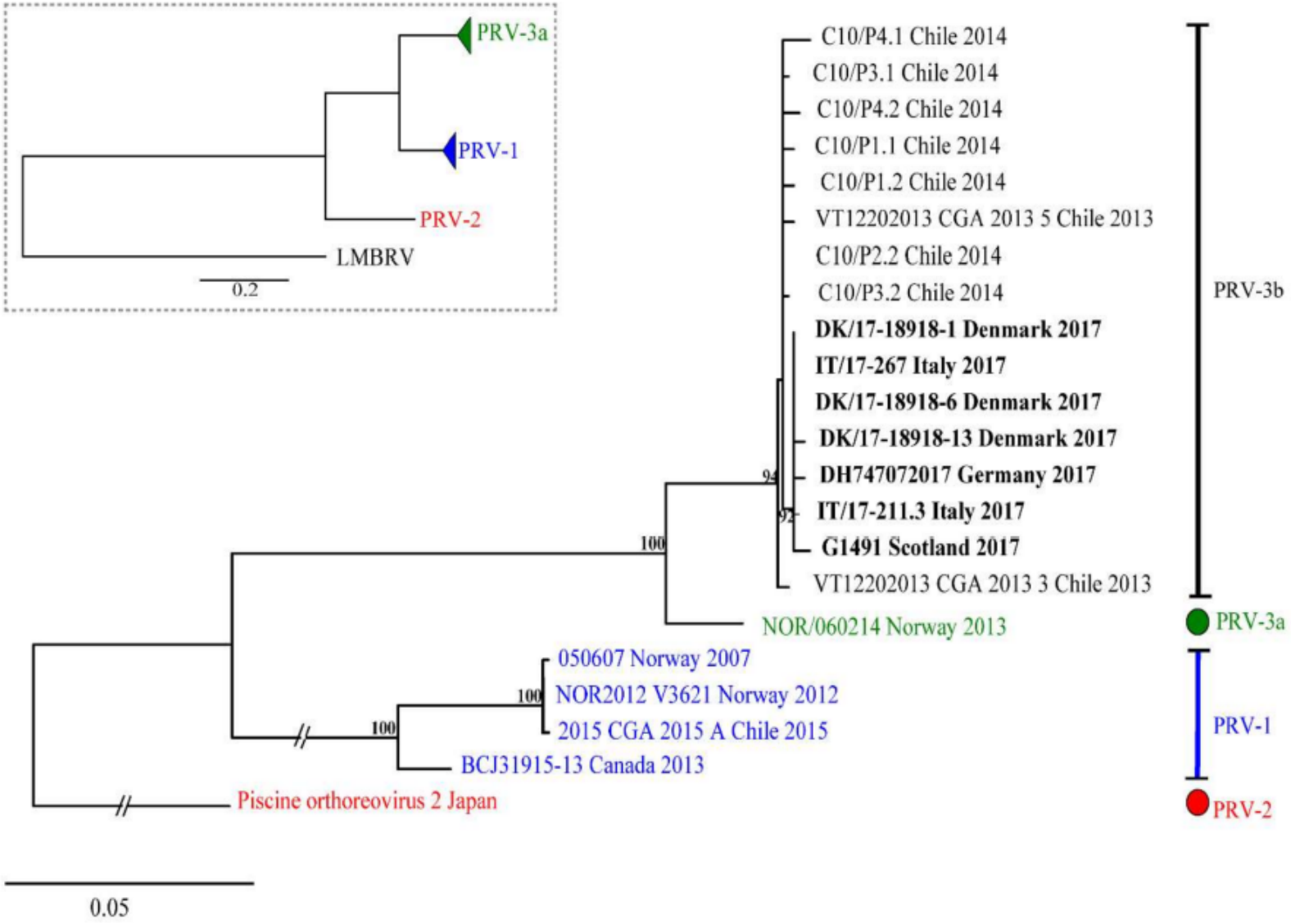
Atlantic salmon

- 50% of fish get infected at peak
- No mortality
- Infects red blood cells
- Causes heart pathology (less than RT)
- No iper expression of MX and Viperin genes

Epidemiology - history of PRV-3



PRV-3 in Europe



PRV-3 in DK

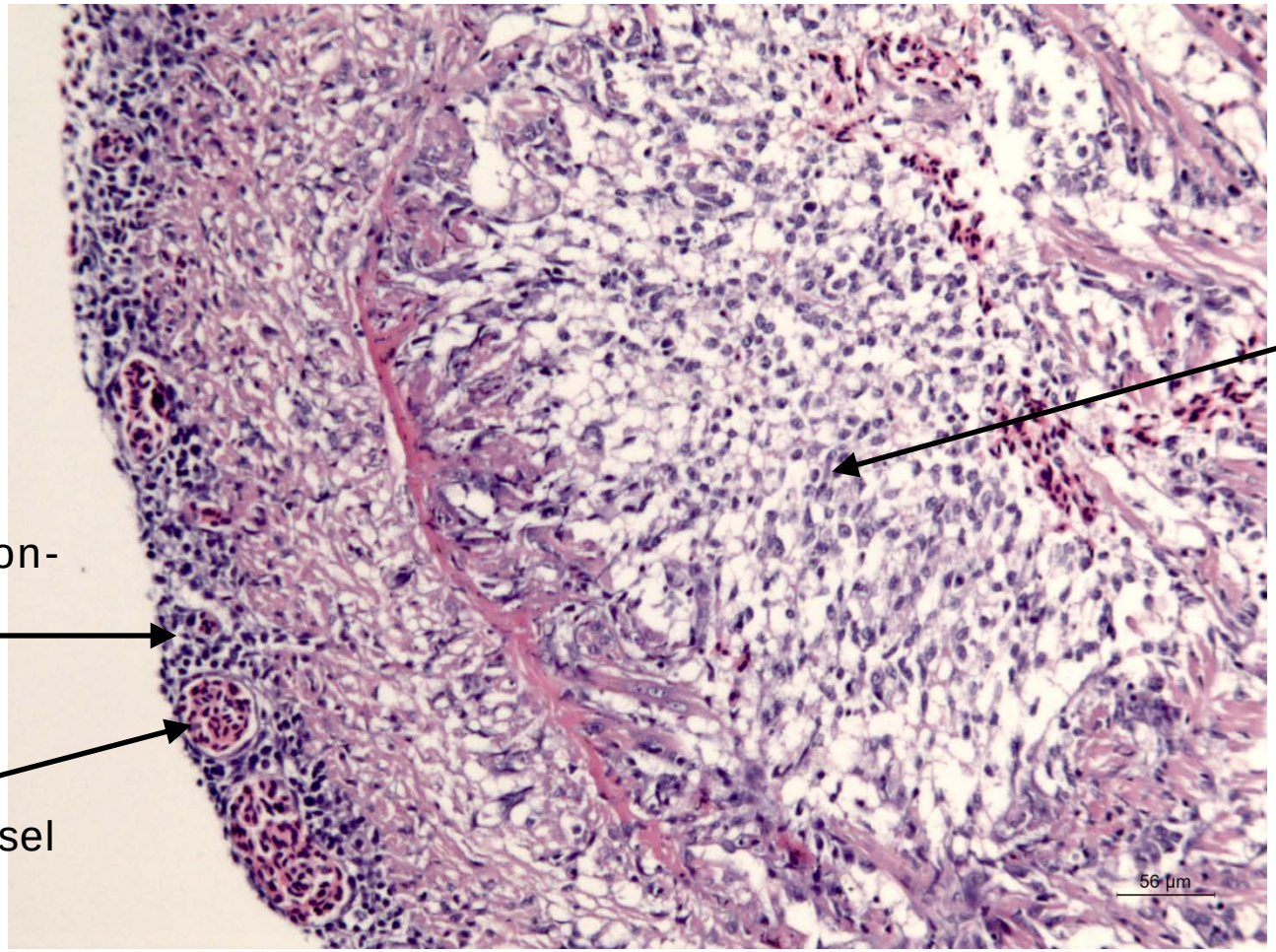
- Affect Rainbow trout in RAS
- Neurological symptoms
- Severe anemia
- Complex disease cases (IPNV, BKD, *F. psychr*.)

Histologically: Epicarditis, maily mild was seen in most of the fish, in a few it is more moderate or severe. Many of the fish have multifocal granulomatous myocarditis and hepatitis indicative of BKD being the main factor.

VIDEO

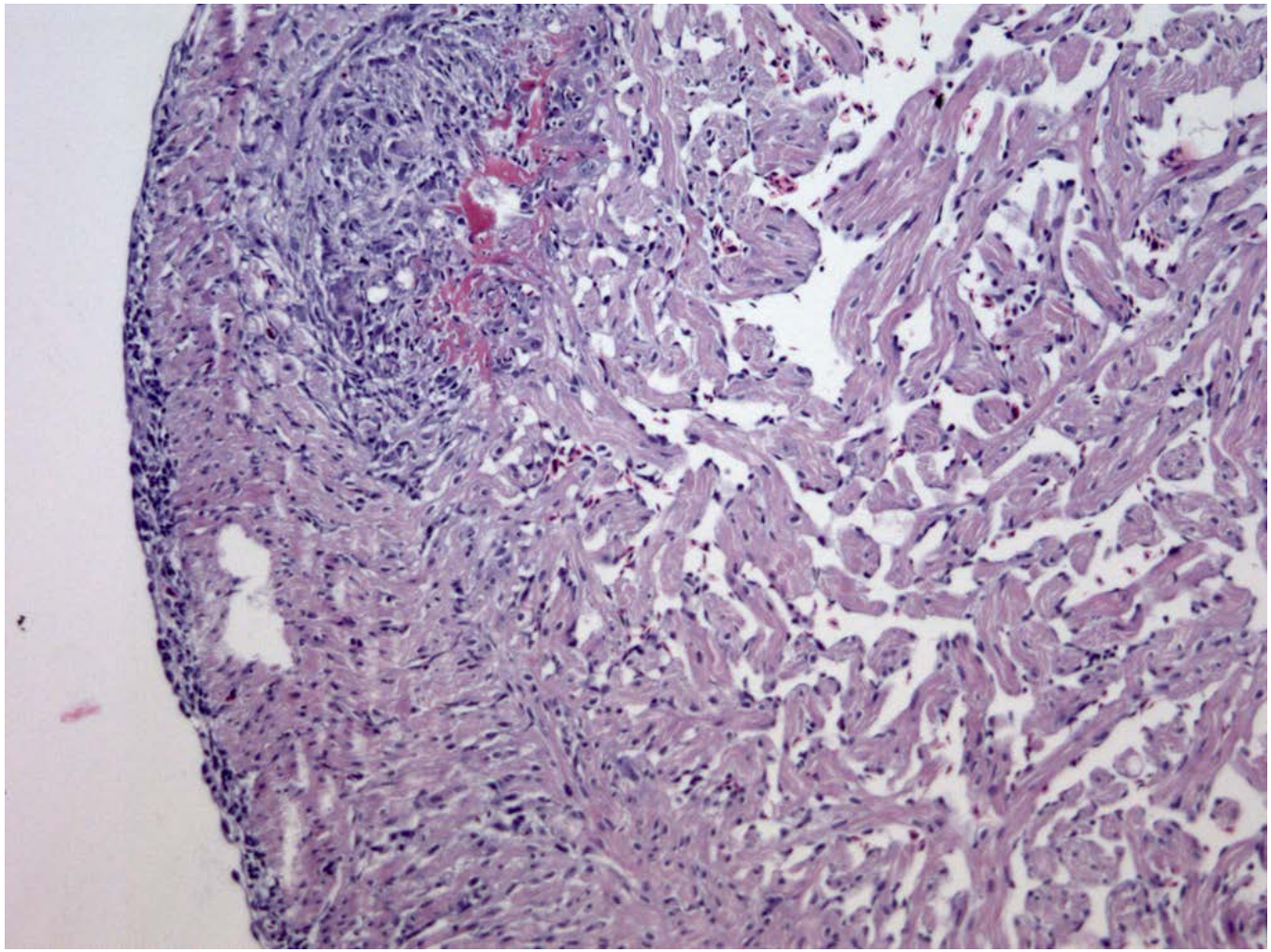
My Movie.mp4

PRV-3 in DK – HEART PATHOLOGY



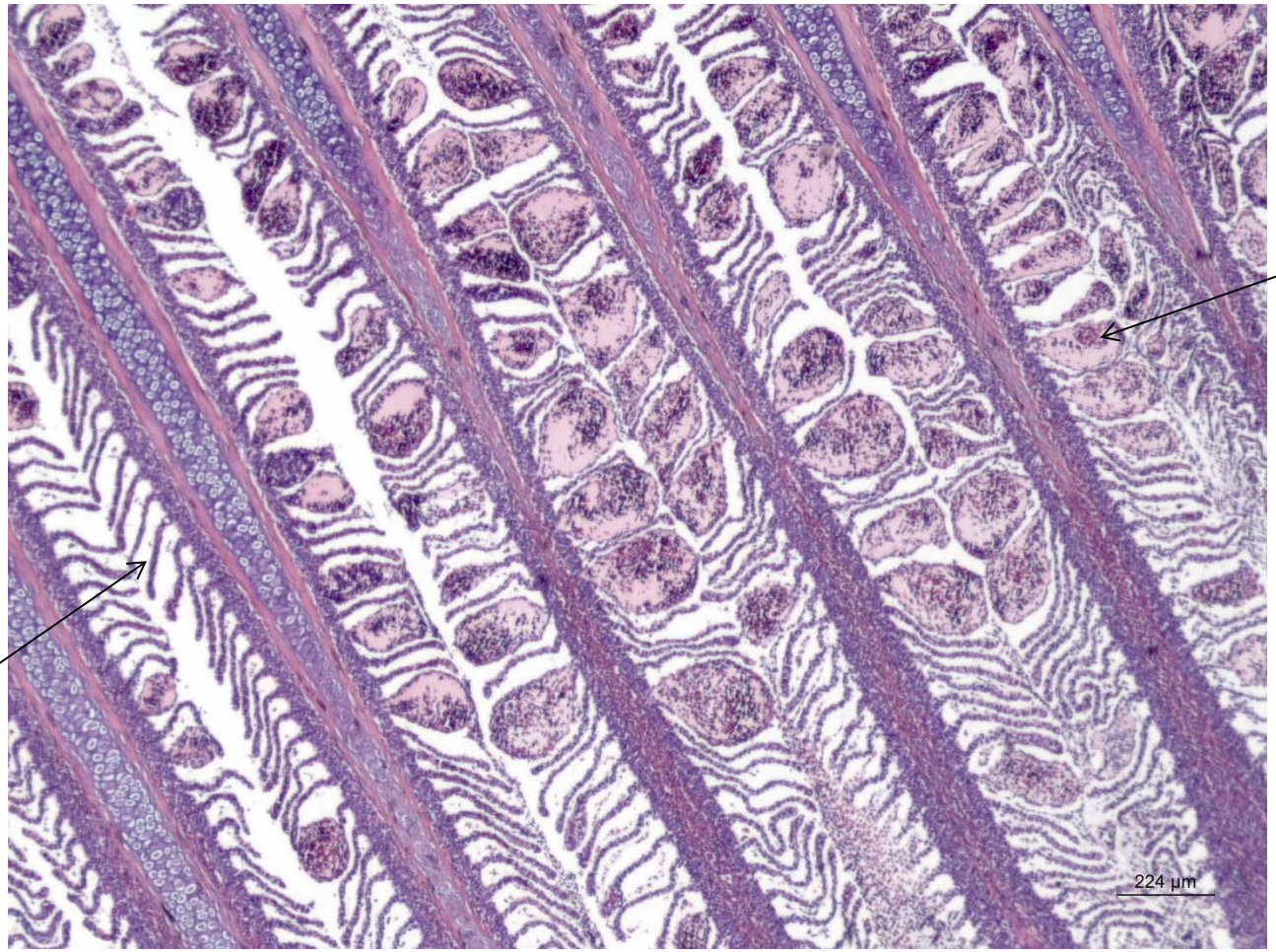
Pic. Tine Iburg

PRV-3 in DK - HEART PATHOLOGY



Pic. Tine Iburg

PRV-3 in DK – Gill PATHOLOGY

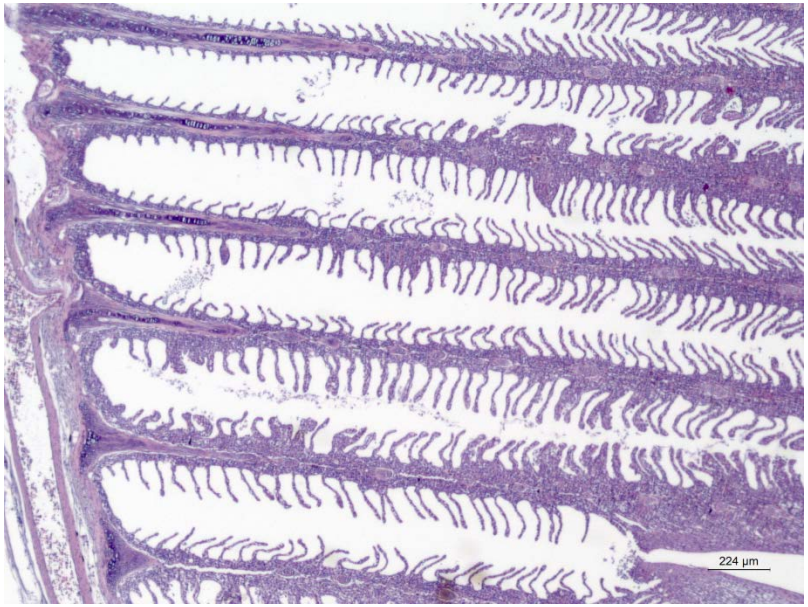


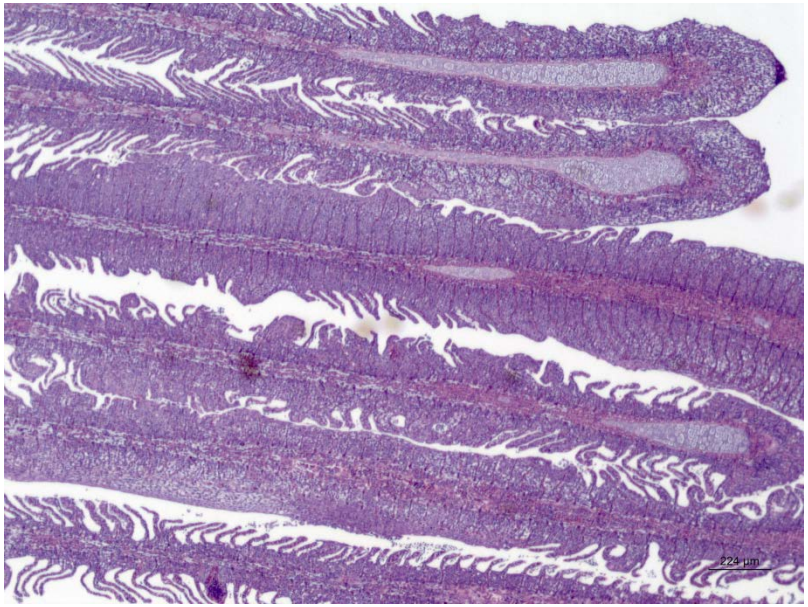
Teleangiectasi og trombe

Normal lamella

Pic. Tine Iburg

PRV-3 in DK – Gill PATHOLOGY





Pic. Tine Iburg

PRV-3 in DK

Symptoms/features	PRV-3 Heart and Spleen	PRV-3 Brain	PRV-3 Gills	Blood Agar Kidney	Blood Agar Brain	TYES Kidney	TYES BRAIN	VU - cells	BKD
P1.1-affected pond-low mortality-Neurological Symptoms	34.97	No Ct	No Ct	neg	neg	neg	Pos. F Pscyhr	Pos IPNV	neg
P1.1-affected pond-low mortality-Neurological Symptoms	No Ct	No Ct	No Ct	neg	neg	neg	neg		
P1.1-affected pond- low mortality-Neurological Symptoms	40.00	No Ct	No Ct	neg	neg	neg	neg		
P1.1-affected pond-low mortality-Neurological Symptoms	37.92	No Ct	No Ct	neg	neg	neg	neg		
P1.1-affected pond-low mortality-Neurological Symptoms	No Ct	No Ct	No Ct	neg	neg	neg	neg		
P1.1-affected pond-Healthy	No Ct	No Ct	No Ct	neg	neg	Pos. F. Psychr.	neg		neg
P1.1-affected pond-Healthy	No Ct	No Ct	No Ct	neg	neg	neg	neg		
P1.1-affected pond-Healthy	37.63	No Ct	No Ct	neg	neg	Pos. F. Psychr.	neg		
P1.1-affected pond-Healthy	No Ct	No Ct	No Ct	neg	neg	neg	neg		
P1.1-affected pond-Healthy	39.91	No Ct	No Ct	neg	neg	neg	neg		
P1.5- gill diseases-	21.72	23.15	21.34	neg	neg	neg	neg	Pos IPNV	susp
P1.5- gill diseases-	25.57	25.28	24.67	neg	neg	neg	neg		
P1.5- gill diseases-	37.55	No Ct	33.65	neg	neg	neg	neg		
P1.5- gill diseases-	36.06	30.80	36.00	neg	neg	neg	neg		
P1.5- gill diseases-	21.34	21.58	21.67	neg	neg	neg	neg		
P1.5- gill diseases-	37.26	No Ct	33.58	neg	neg	neg	neg		susp
P1.5- gill diseases-	No Ct	No Ct	35.32	neg	neg	neg	neg		
P1.5- gill diseases-	No Ct	No Ct	No Ct	neg	neg	neg	neg		
P1.5- gill diseases-	23.85	24.17	21.67	neg	neg	neg	neg		
P1.5- gill diseases-	31.80	31.20	28.38	neg	neg	neg	neg		

P 4.1 Pool of Heart and Spleen	26.05
P 4.1 Pool of Heart and Spleen	24.00
P 4.1 Pool of Heart and Spleen	24.29
P 4.1 Pool of Heart and Spleen	24.60
P 4.1 Pool of Heart and Spleen	25.91
P 4.1 Pool of Heart and Spleen	26.64

Healthy looking fish at sampling, suffered severe disease 2 weeks after the visit

PRV-3 in DK

Symptoms/features	PRV-3 Heart and Spleen	PRV-3 Brain	PRV-3 Gills	Blood Agar Kidney	Blood Agar Brain	TYES Kidney	TYES BRAIN	VU - cells	BKD
Neurological symptoms M3	21.86	25.98	24.77	neg	neg	Pos F.Psychr.	Pos F.Psychr.		
Neurological symptoms M3	20.16	27.56	22.95	neg	neg	Pos F.Psychr.	Pos F.Psychr.		
Neurological symptoms M3	22.28	27.38	25.22	neg	neg	neg	Pos F.Psychr.		Susp
Neurological symptoms M3	25.88	25.94	26.42	neg	neg	neg	neg		
Neurological symptoms M3	37.00	No Ct	31.31	neg	neg	Pos F.Psychr.	Pos F.Psychr.	NEG	
healthy	22.21	26.06	24.57	neg	neg	neg	neg		
healthy	21.92	24.07	23.54	neg	neg	neg	neg		
healthy	20.32	25.64	23.57	neg	neg	neg	Pos F.Psychr.		Susp
healthy	23.44	28.58	25.53	neg	neg	neg	neg		
healthy	26.19	27.08	26.16	neg	neg	neg	neg		
Neurological symptoms	32.03	No Ct	34.80	neg	neg	neg	neg		
Neurological symptoms	25.06	25.77	27.86	neg	neg	Pos F.Psychr.	Pos F.Psychr.		
Neurological symptoms	32.95	No Ct	34.45	neg	neg	Pos F.Psychr.	neg		POS
healthy	28.61	28.40	31.81	neg	neg	neg	neg		
healthy	34.11	No Ct	38.35	neg	neg	neg	neg	NEG	
healthy	31.47	No Ct	34.30	neg	neg	Pos F.Psychr.	neg		
healthy	20.57	24.93	24.21	neg	neg	neg	neg		
healthy	26.36	27.49	29.91	neg	neg	neg	neg		Susp
healthy	31.10	No Ct	35.21	neg	neg	neg	neg		
healthy	29.95	32.00	31.31	neg	neg	Pos F.Psychr.	Pos F.Psychr.		
Healthy after 8 weeks of outbreak	39.03	No Ct	No Ct	neg	neg	neg	neg		
Healthy after 8 weeks of outbreak	38.69	No Ct	No Ct	neg	neg	neg	neg		
Healthy after 8 weeks of outbreak	No Ct	No Ct	No Ct	neg	neg	neg	neg		Susp
Healthy after 8 weeks of outbreak	No Ct	No Ct	No Ct	neg	neg	neg	neg		
Healthy after 8 weeks of outbreak	37.22	No Ct	No Ct	neg	neg	neg	neg		
Healthy after 8 weeks of outbreak	No Ct	No Ct	No Ct	neg	neg	neg	neg	NEG	
Healthy after 8 weeks of outbreak	No Ct	No Ct	No Ct	neg	neg	neg	neg		
Healthy after 8 weeks of outbreak	No Ct	No Ct	No Ct	neg	neg	neg	neg		NEG
Healthy after 8 weeks of outbreak	38.95	No Ct	No Ct	neg	neg	neg	neg		
Healthy after 8 weeks of outbreak	No Ct	No Ct	No Ct	neg	neg	neg	neg		

PRV-3 in DK Industry funded project

Prevalence study: so far 40 farms tested. 30 fish sampled , 5 fish pools of spleen and heart by qPCR. 25 positives.

Virulence comparison under experimental condition. Work ongoing

Eggs disinfection procedures .

Acknowledgements

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Thank you for your attention