Hjertehelse - erfaringer fra diagnostikken

FHF dialogmøte - Med hjerte for oppdrettsfisken

Helene Wisløff, Pharmaq Analytiq

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zoetis

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Aktuelle hjertediagnoser

- Myokarddegenerasjon og andre forandringer i kompakt hjertemuskulatur
- Arteriosklerose
- Betennelse og forkalkninger i hjerteklaffer
- Hjertepigg
- Deformiteter
- Ventrikulær hypoplasi

- HSMB
- CMS
- PD

- AI-modell for hjertebetennelse

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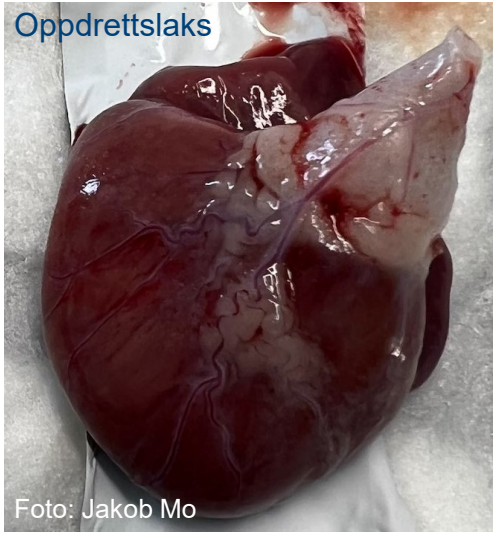
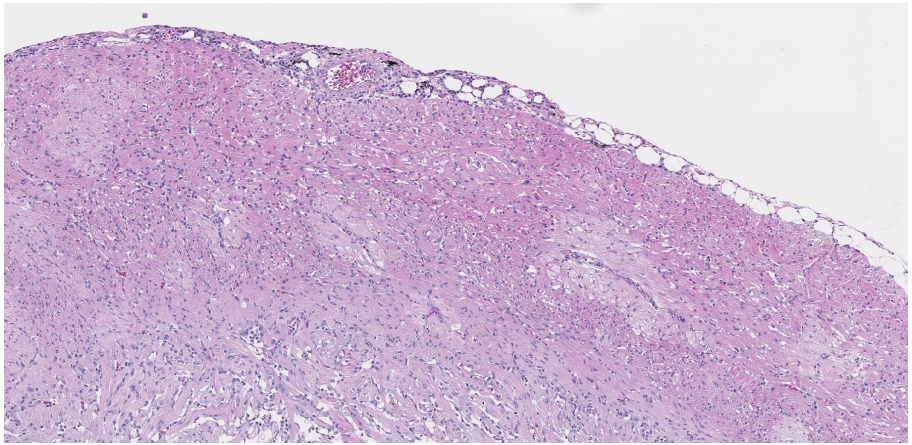
Myokarddegenerasjon

- Lesjoner i kompakt hjertemuskulatur
- Atlantisk laks og regnbueørret
- Assosiert med stress (ikke-medikamentell lusebehandling, transport, store temperaturforandringer)
- Obduksjonsfunn: blod i hjertesekk, store hjerter, avvikende hjerteform, blek hjertemuskulatur, ascites, stuvning





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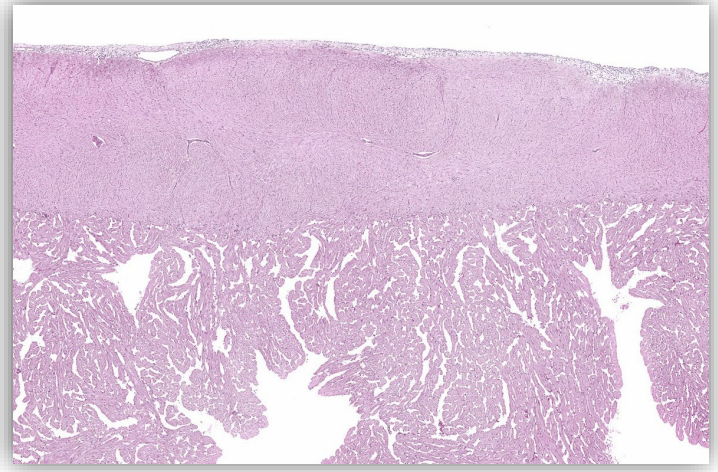
Myokarddegenerasjon

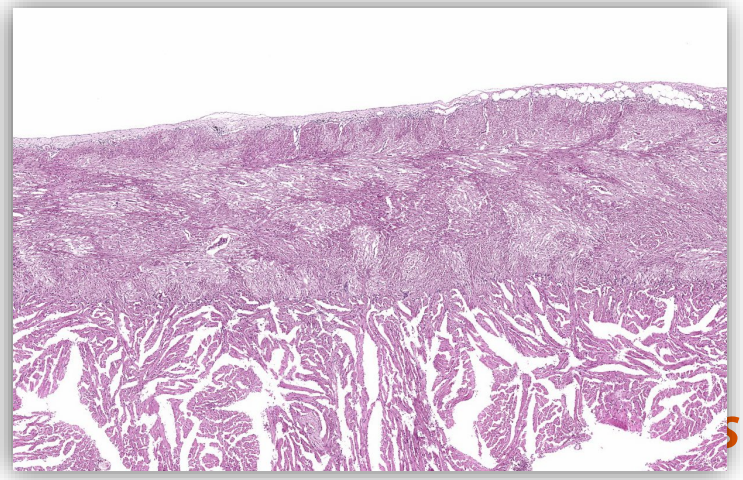
Histopatologiske forandringer

- Multifokale lyse områder i kompakt hjertemuskulatur med svulne hjertemuskelceller med granulært eller vakuolisert cytoplasma
- Lesjonene er lokalisert rundt forgreninger av koronararteriene
- Ingen betennelsesreaksjon

Villaks, normal histologi



Oppdrettslaks, myokarddegenerasjon



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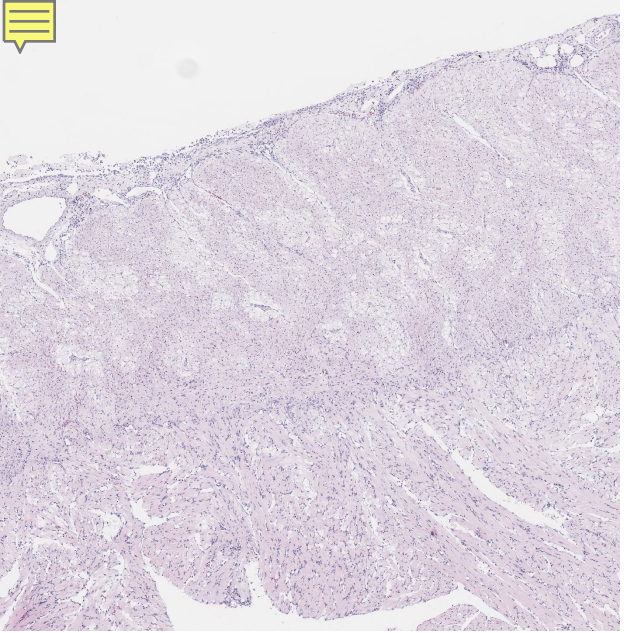
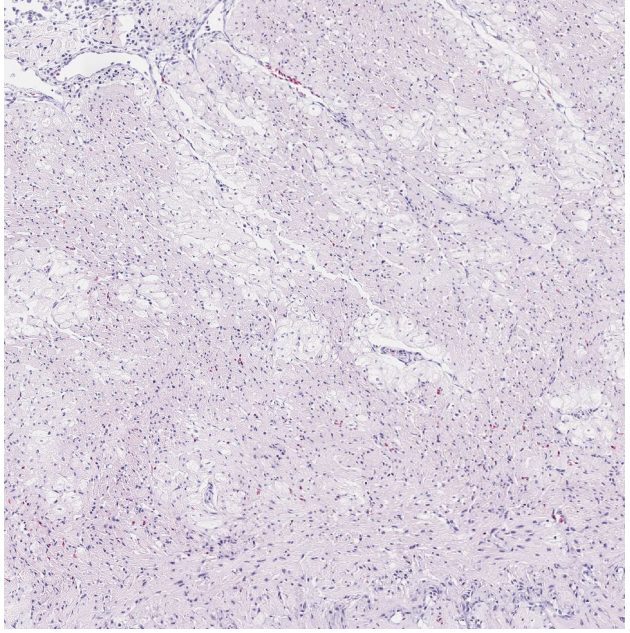
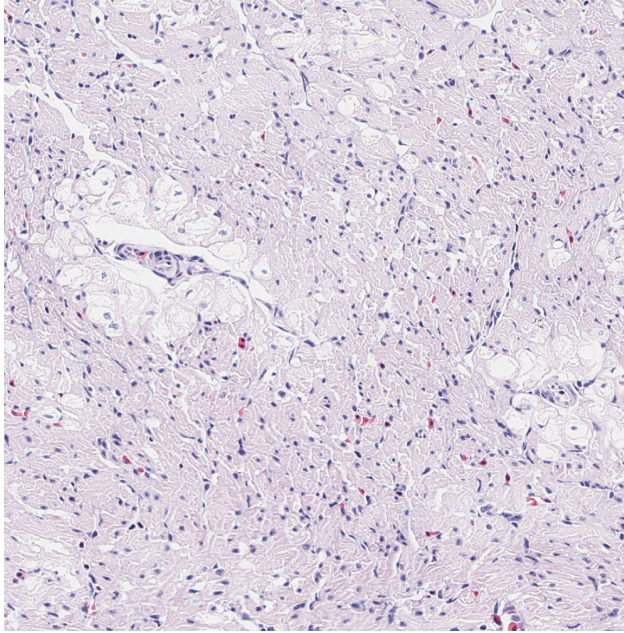




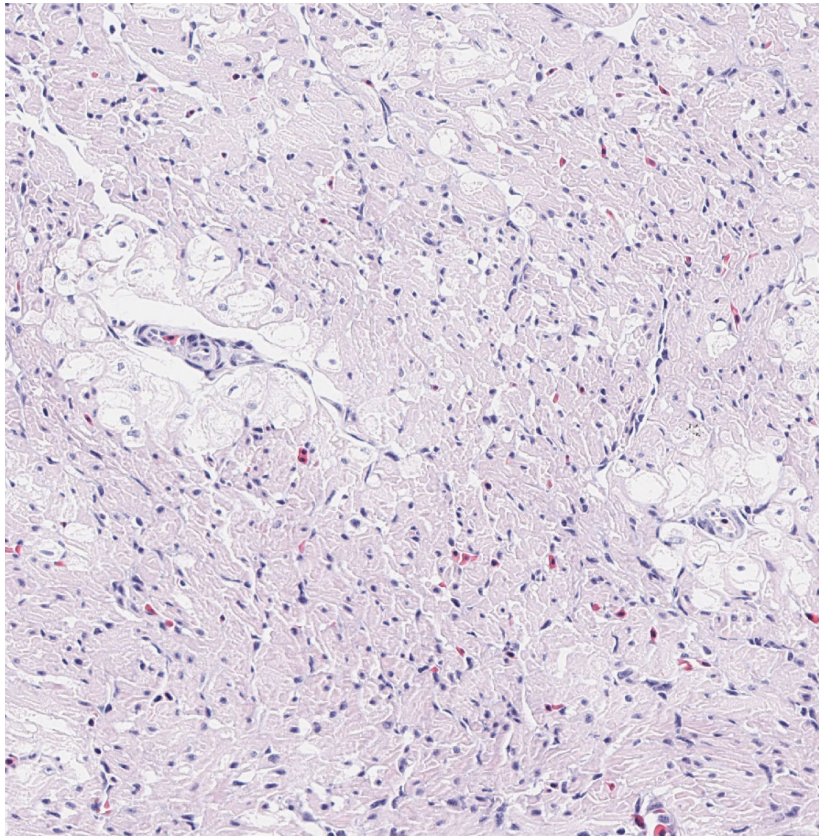


Eksempel
Laks død etter termisk lusebehandling

- Multifokale lyse områder i kompakt hjertemuskulatur
- Lesjonene er lokalisert rundt forgreninger av koronarkar
- Lyse svulne hjertemuskelceller

Mulige årsaker

- Forandringene tolkes som degenerasjon av hjertemuskelceller
- Ischemiske forandringer
- Nedsatt funksjon i koronararteriene
- Spasme i koronararteriene (CAS)
- Akutt koronarsyndrom (ACS)
- Arteriosklerose



SHORT COMMUNICATION

Journal of Fish Diseases WILEY

Novel myocardial pathology in farmed salmonids

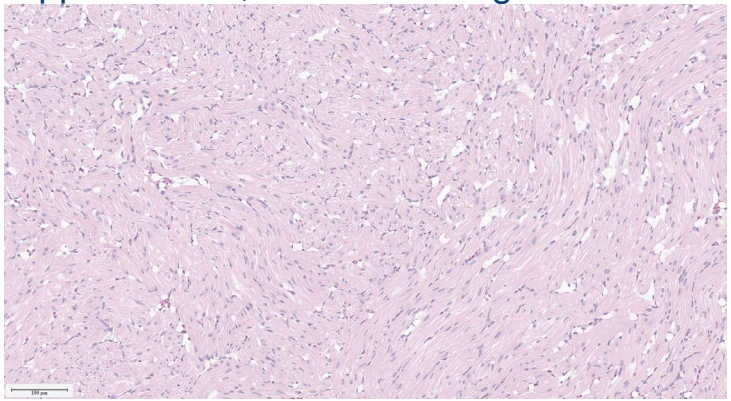
Trygve T. Poppe | Anne Katrine Reed | Mette Hofossæter | Helene Wisløff

Myokarddegenerasjon

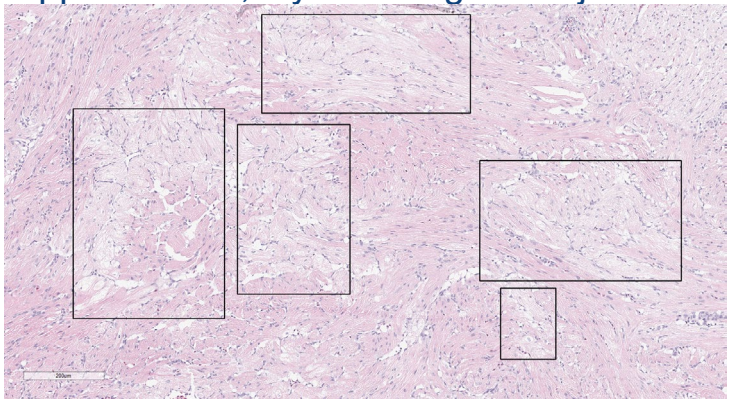
Lesjoner i spongiøst myokard

- Samme type forandringer som vi ser i kompakt hjertemuskulatur med svulne hjertemuskelceller med granulært eller vakuolisert cytoplasma
- Årsak?

Oppdrettslaks, normal histologi

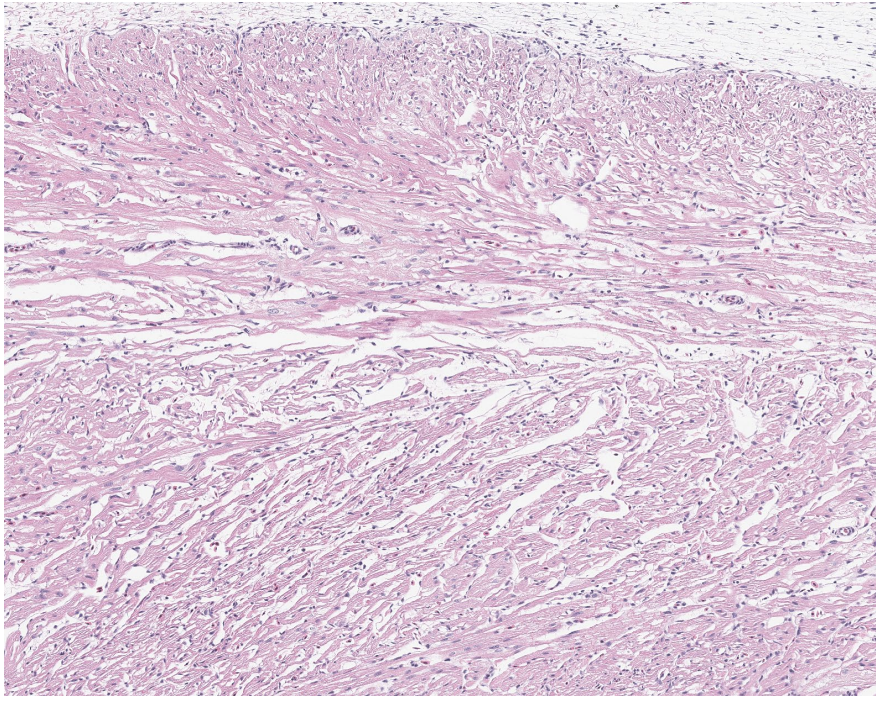


Oppdrettslaks, myokarddegenerasjon

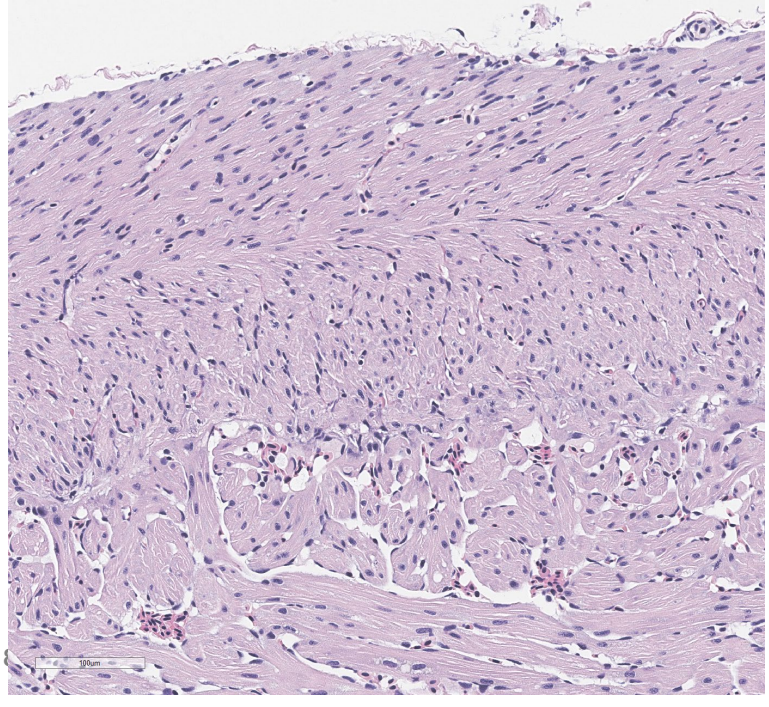


Andre histopatologiske forandringer i kompakt hjertemuskulatur

Frasprengte muskelfibre

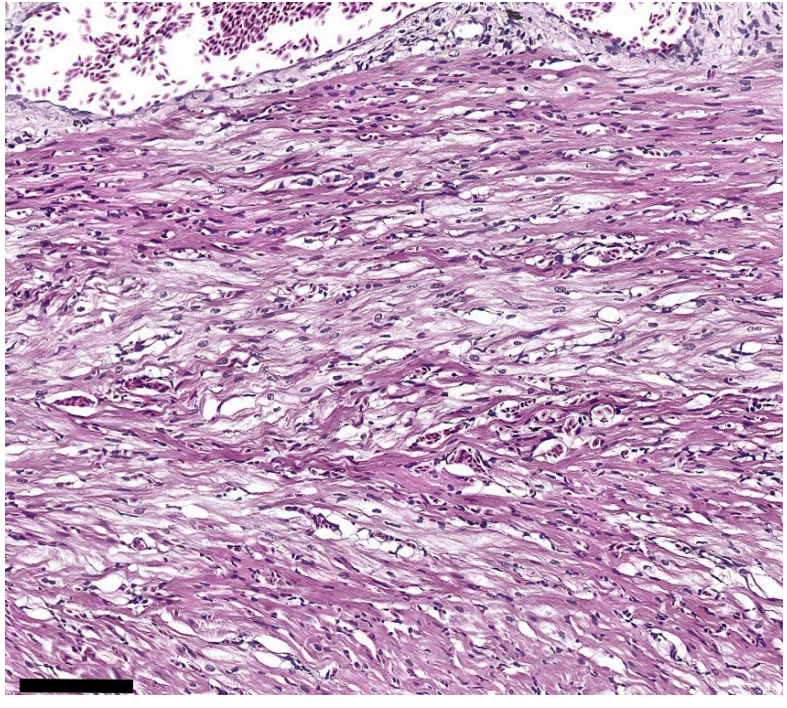


Normal kompakt hjertemuskulatur

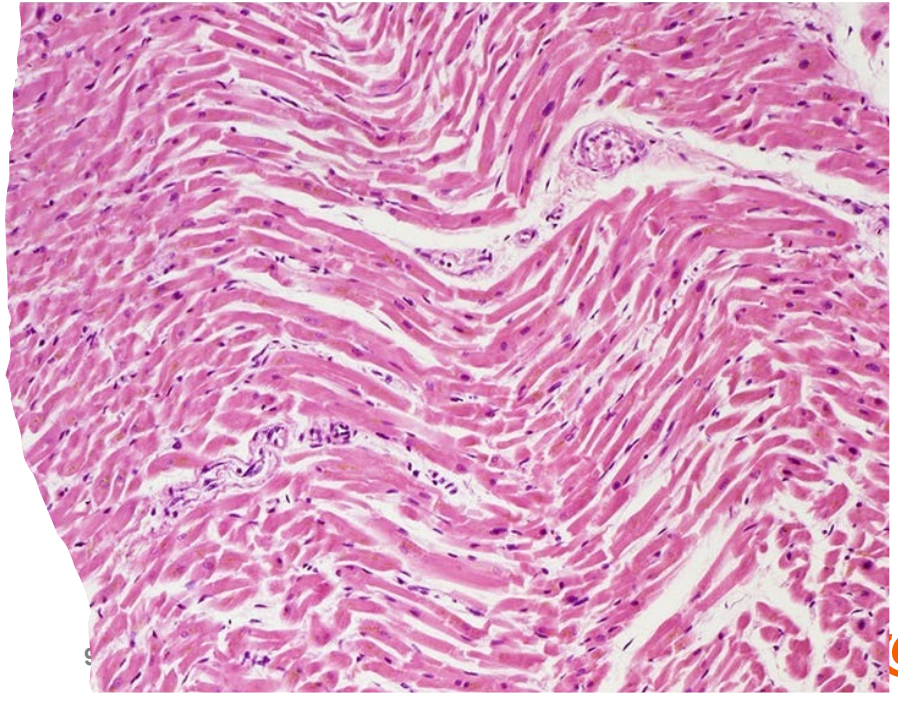


Andre histopatologiske forandringer i kompakt hjertemuskulatur

Myokarddegenerasjon og bølgede fibre, laks

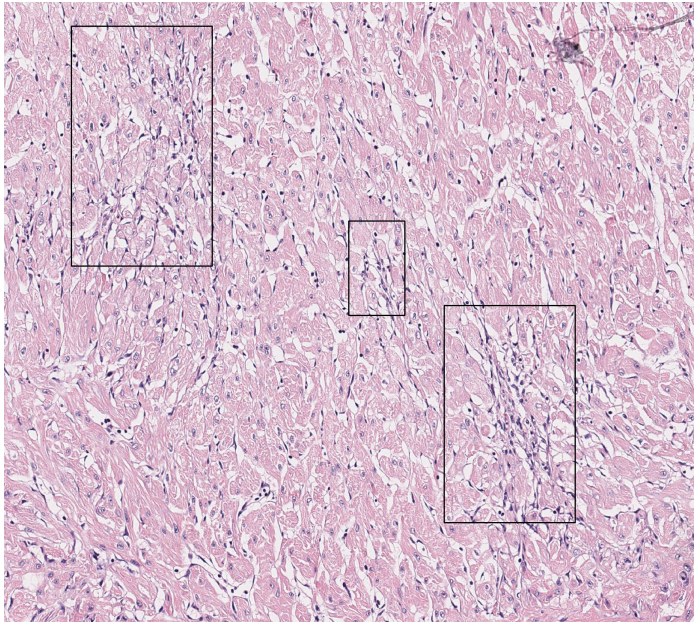


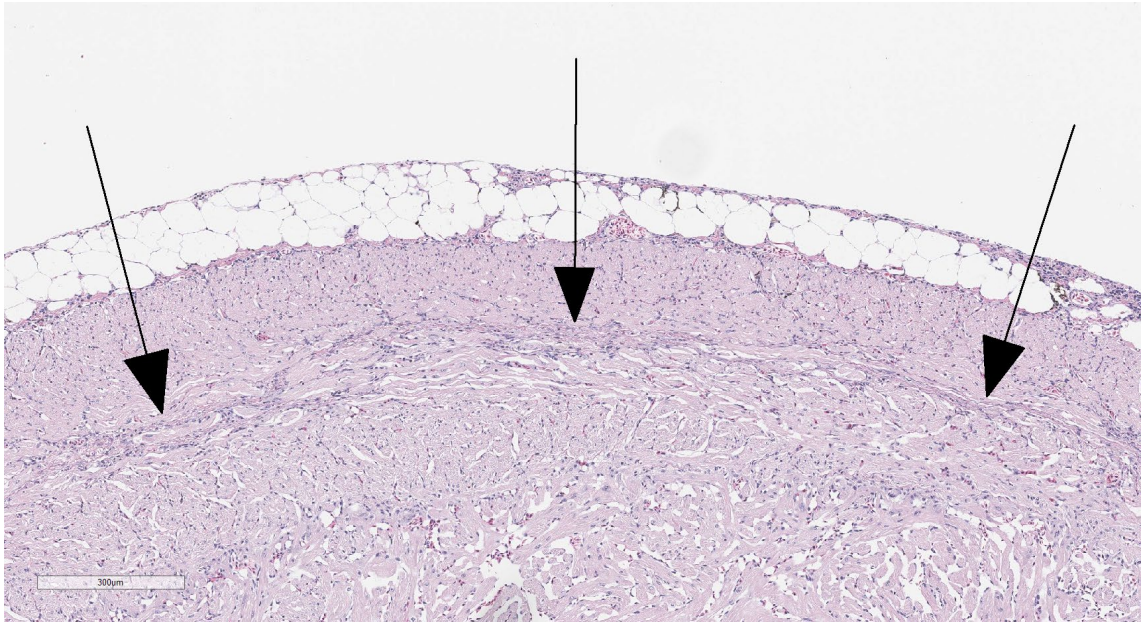
Hjertemuskulatur fra menneske. Michaud et al 2019



Andre histopatologiske forandringer i kompakt hjertemuskulatur

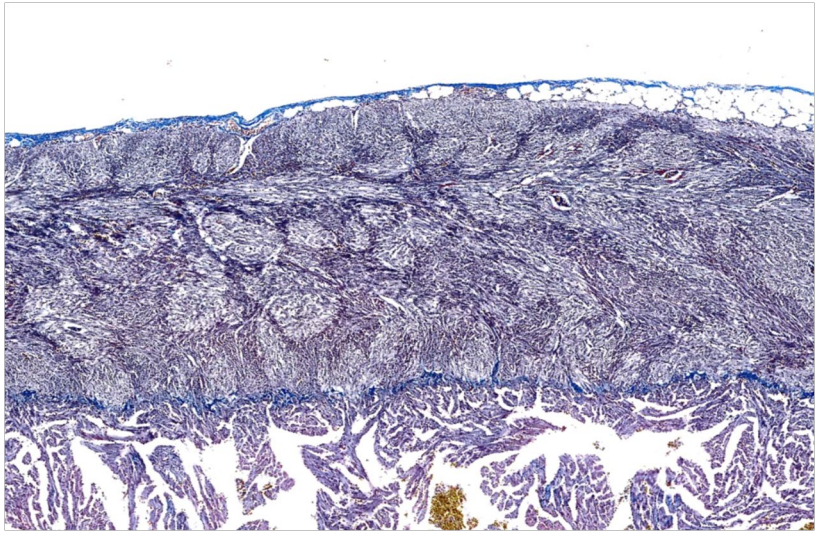
Fibrose



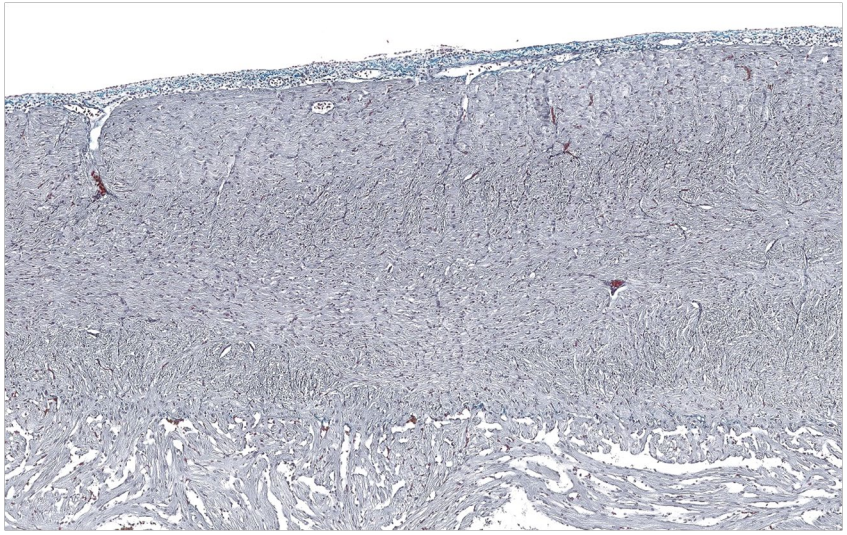


Andre histopatologiske forandringer i hjertemuskulatur

Oppdrettslaks, myokarddegenerasjon



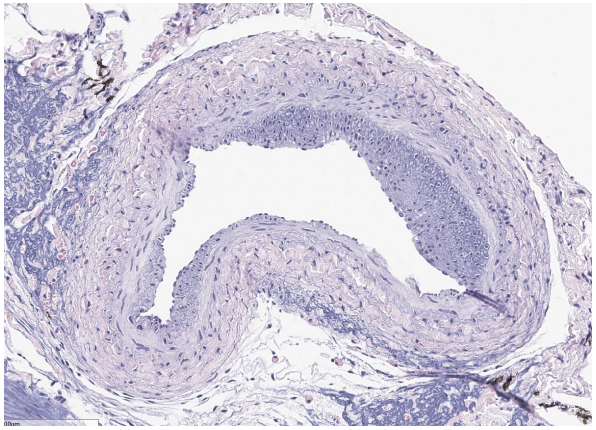
Villaks, normal histologi

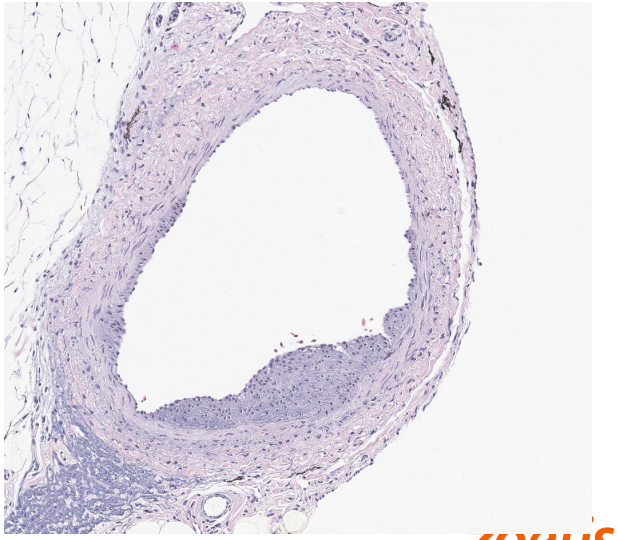


Arteriosklerose

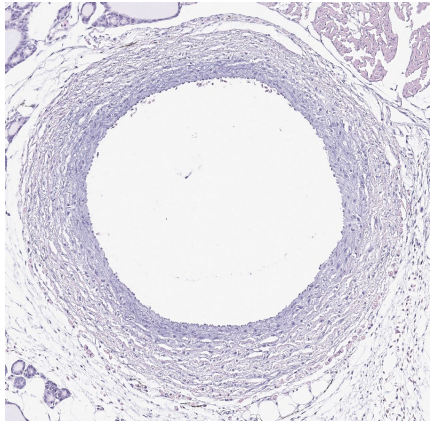
- Fortykket karvegg i arterier, proliferasjon av glatt muskulatur +/- betennelse
- Vanlig funn hos laks
- Sammenheng med avvikende hjertemorfologi?
- Sammenheng med myokarddegenerasjon?
- Flere pågående prosjekter

Arteriosklerose i koronararterier





Normal koronararterie



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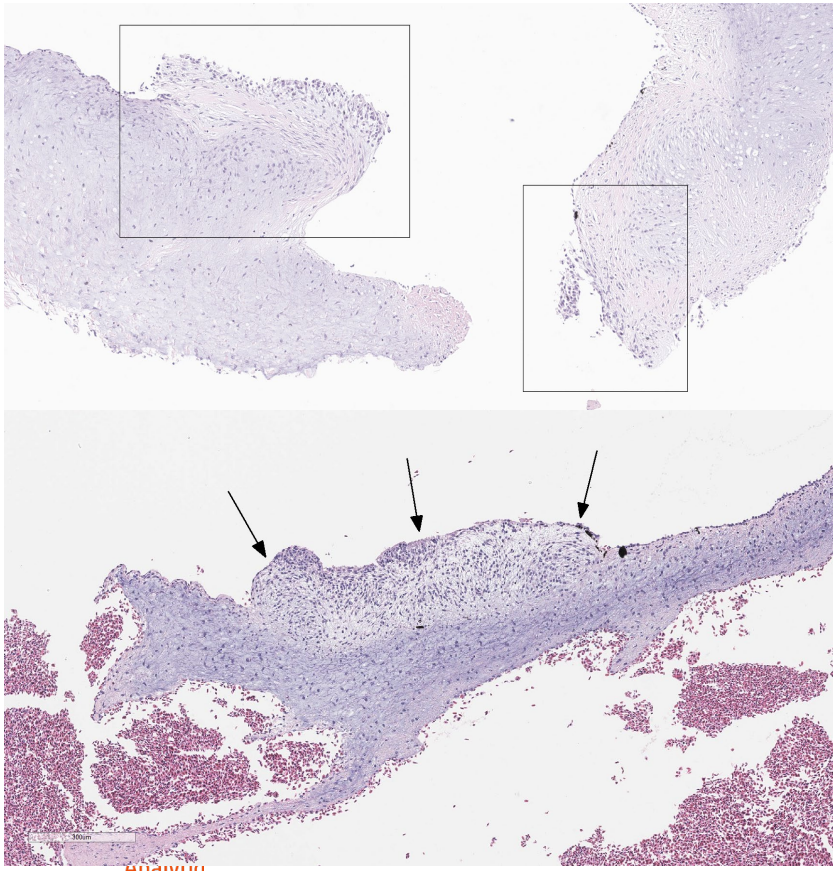
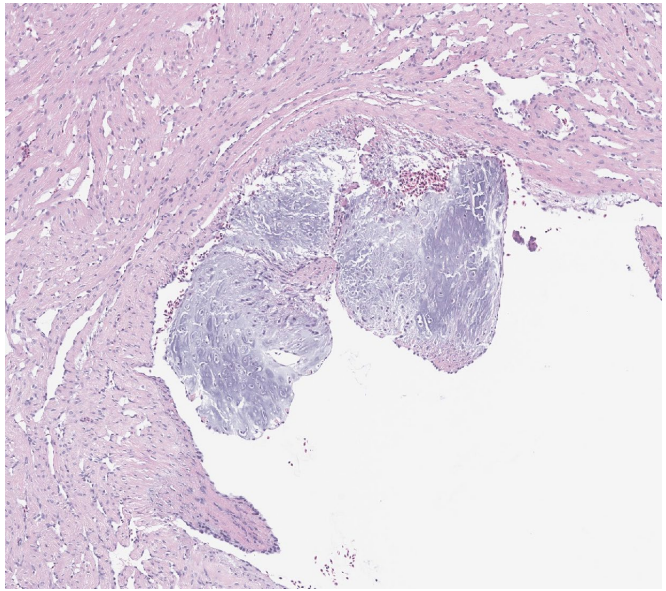
Betennelse i hjerteklaffer

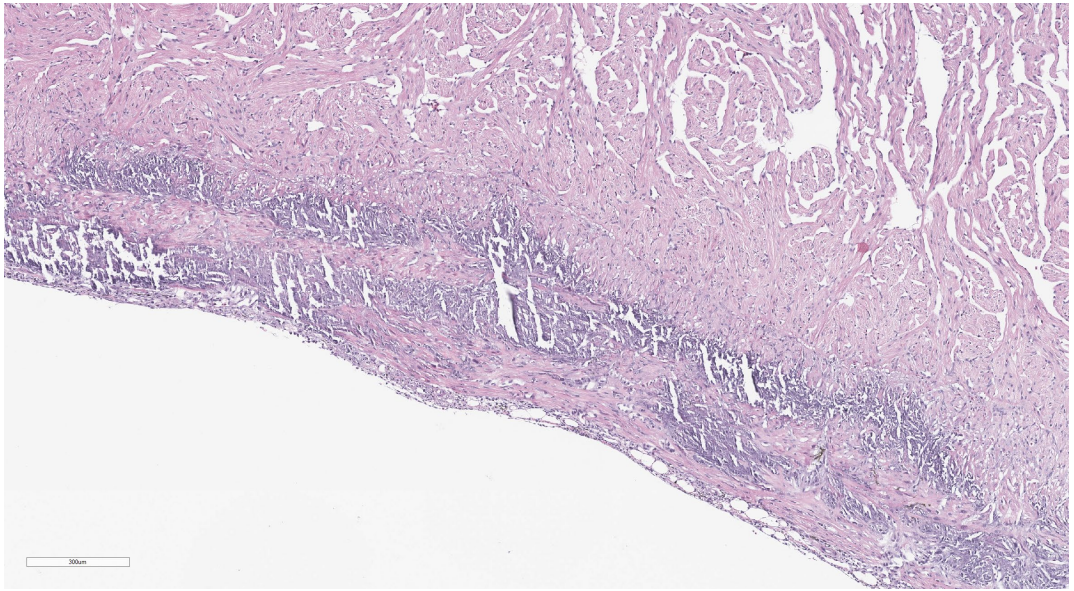


- Hyperplasi (fortykkelse) av endokard
- Infiltrasjon betennelsesceller

- <u>Mulige årsaker:</u>
- Infeksjoner
- Deformiteter (turbulens)
- Gassbobler

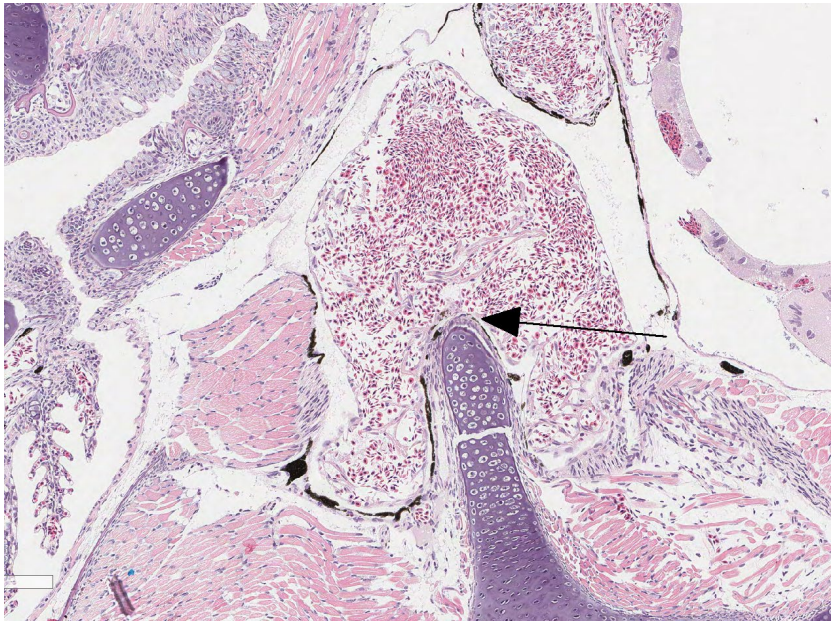
Forkalkning i hjerteklaffer (og myokard)





«Hjertepigg»

- Bruskpigg som er en del av skjelettet ventralt i hoderegionen
- Sporadisk funn hos lakseyngel
- Et eller flere individer i en gruppe
- Lignende funn rapportert fra UK, Færøyene og Chile



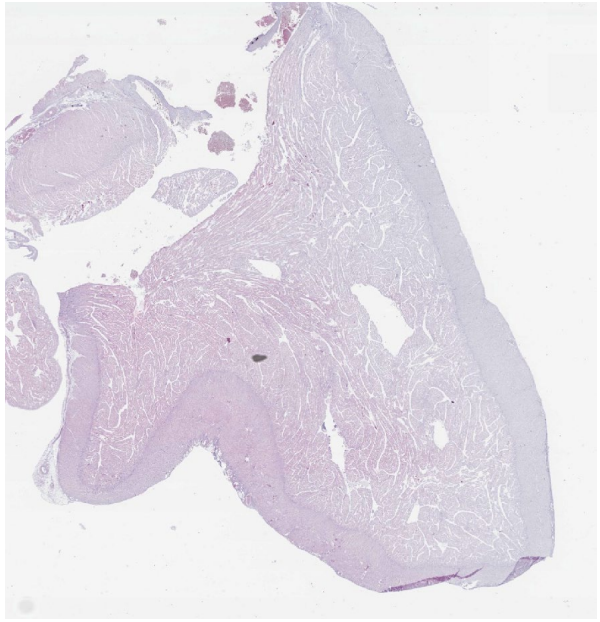
SHORT COMMUNICATION

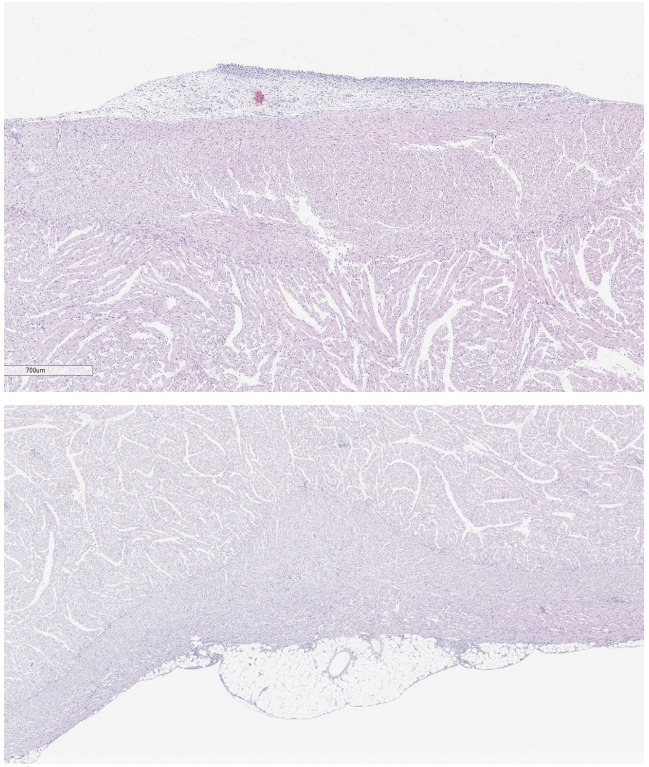
Journal of Fish Diseases — WILEY

Basibranchial structure affecting cardiac morphology in Atlantic salmon (*Salmo salar* L.)

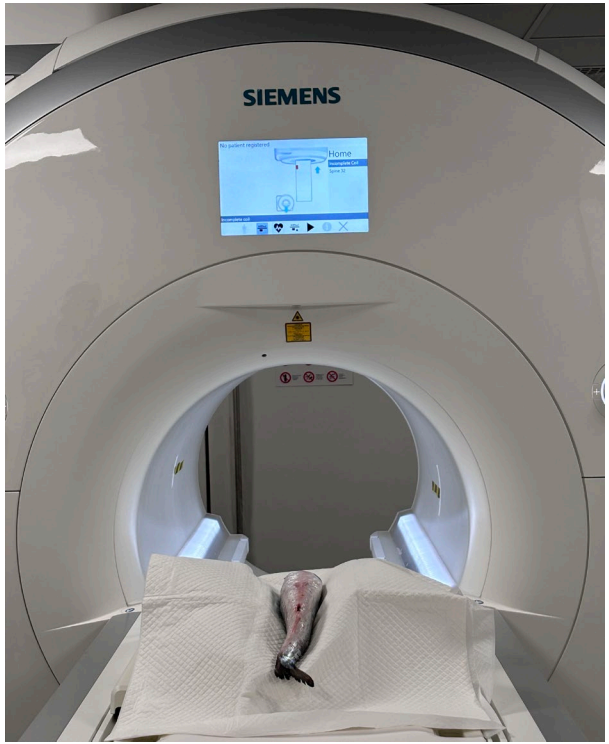
Trygve T. Poppe | Anne Katrine Reed | Helene Wisløff

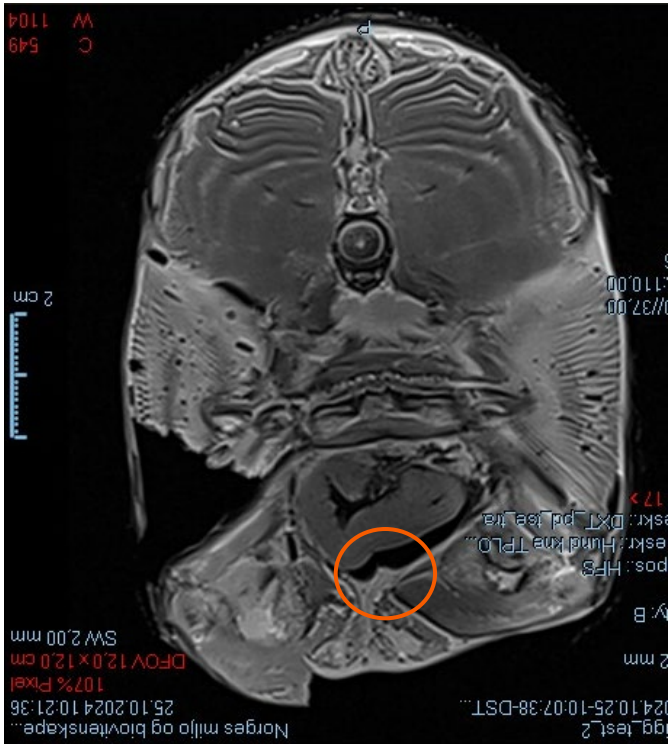
Mulige resultater av hjertepigg





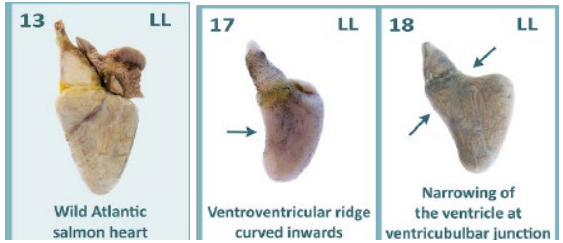
Videre studier av hjertepigg





Hjertedeformiteter

- Mye avvikende hjertemorfologi hos oppdrettslaks



Aquaculture 578 (2024) 740046

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/aquaculture

Short communication

State of the heart: Anatomical annotation and assessment of morphological cardiac variation in Atlantic salmon (*Salmo salar* L.)

Vilde Arntzen Engdal [a], Alf Seljenes Dalum [b], Harald Kryvi [c], Michael Frisk [d,e], Håkon Torsvik [f], Kjetil Hodne [a], Harriet Romstad [g,1], Ida Beitnes Johansen [a,*,1]

Aquaculture 591 (2024) 741145

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journal homepage: www.elsevier.com/locate/aquaculture

Automated assessment of cardiac morphological variation in Atlantic salmon (*Salmo salar* L.)

Lisa-Victoria Bernhardt [a,*,1], Andreas Hafver [a,1], Nafiha Usman [a], Edward Yi Liu [a], Jørgen Andreas Åm Vatn [a], André Ødegårdstuen [b], Heidi S. Mortensen [c], Ida Beitnes Johansen [d]

Aquaculture Reports 42 (2025) 102730

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Aquaculture Reports

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Physiological performance and cardiac morphology of Atlantic salmon reared under slow and fast growth conditions

Malthe Hvas [a,*], Ole Folkedal [a], Marco A. Vindas [b], Ida B. Johansen [b]

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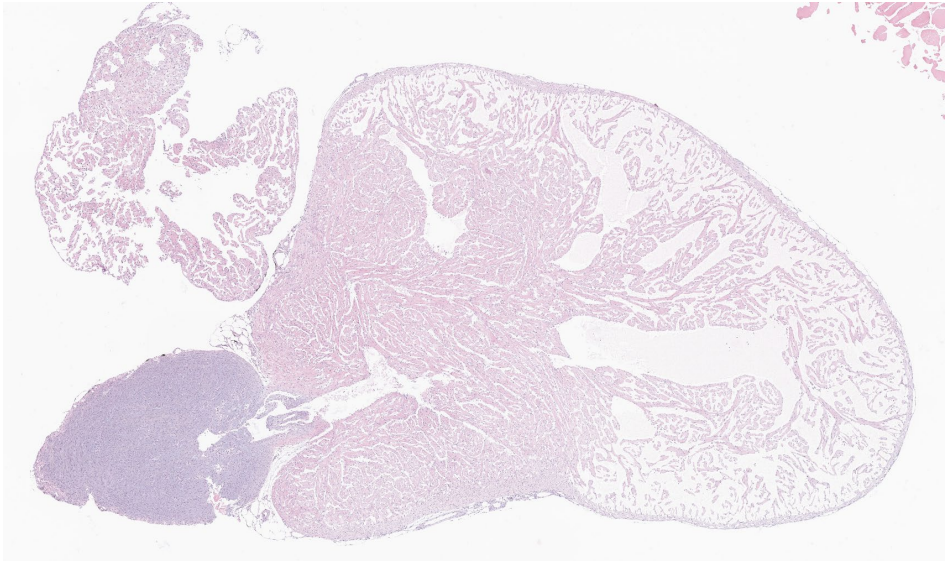
Ventrikulær hypoplasi

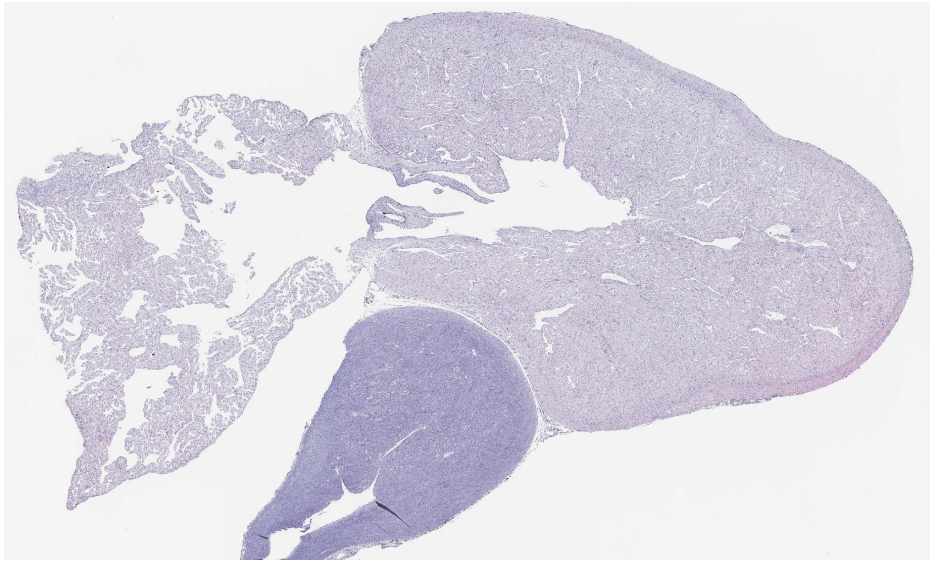
Vol. 42: 35–40, 2000 | DISEASES OF AQUATIC ORGANISMS Dis Aquat Org | Published August 10

Ventricular hypoplasia in farmed Atlantic salmon *Salmo salar*

Trygve T. Poppe[1,*], Torunn Taksdal[2]

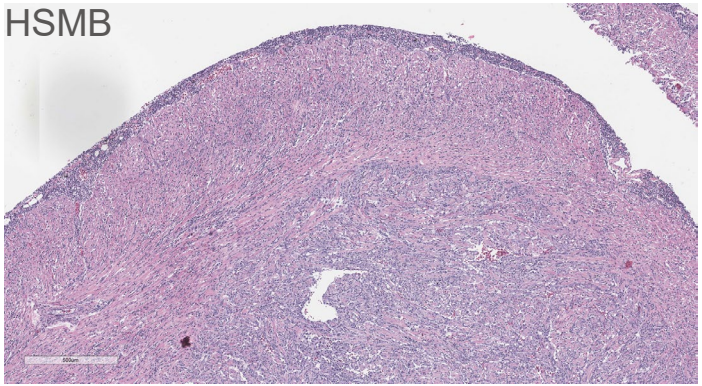
[1]The Norwegian School of Veterinary Science, PO Box 8146, Dep., 0033 Oslo, Norway
[2]National Veterinary Institute, PO Box 8156, Dep., 0033 Oslo, Norway

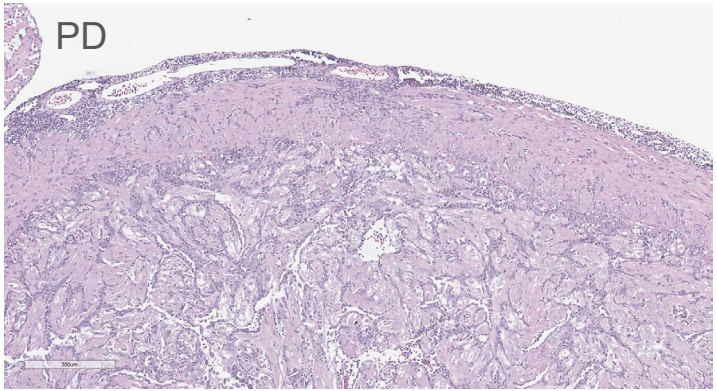


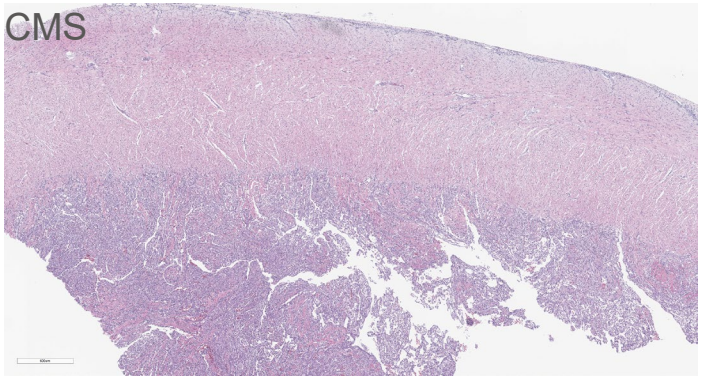


Virussykdommer som affiserer hjertet

- Hjerte- og skjelettmuskelbetennelse (HSMB)
- Kardiomyopatisyndrom (CMS)
- Pankreas sykdom (PD)





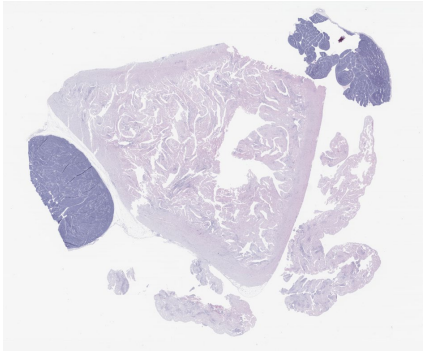


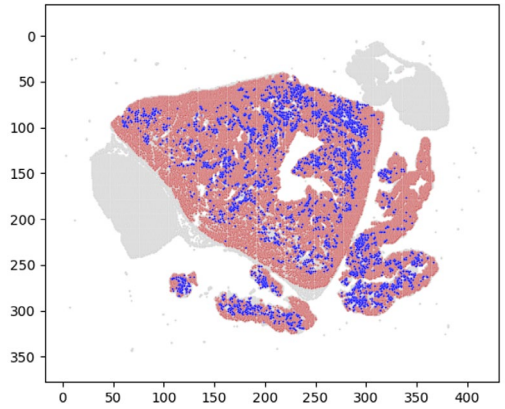
Myocardial inflammation model - AI

Estimating extent of myocardial inflammation in whole slide images (WSI)

- Each WSI is divided into multiple sectors
- For each sector in the slide prediction (classification) is done using two different ML models:
  - Myocarditis detection model
  - Myocardium detection model (performance details not presented)

$$\text{Extent of myocardial inflammation} = \frac{\text{Area of inflamed myocardium}}{\text{Area of myocardium}}$$





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Myocardial inflammation model - AI

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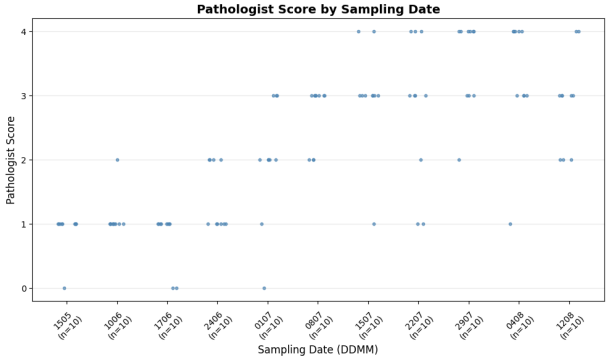
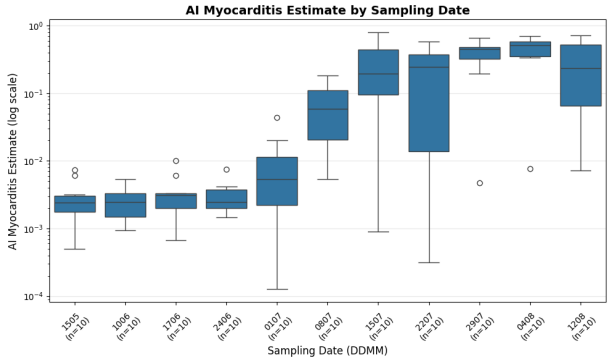
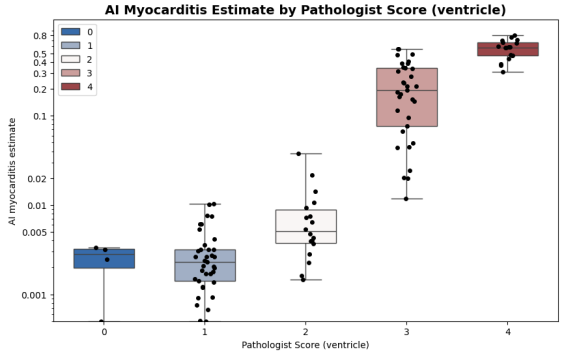
Myocardial inflammation model - AI

Customer submitted HSMI project samples







Correlation between AI myocarditis estimate and myocarditis Score (ventricle): Spearman correlation: ***0.89***, P-value << 0.0001

Takk for oppmerksomheten!

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