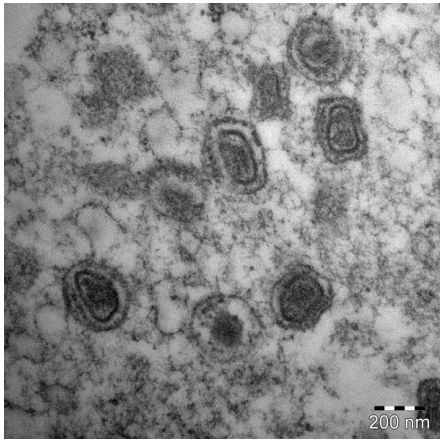
Salmon gill poxvirus disease

Mona Cecilie Gjessing, Even Thoen, Torstein Tengs, Ole Bendik Dale

Norwegian Veterinary Institute



Veterinærinstituttet
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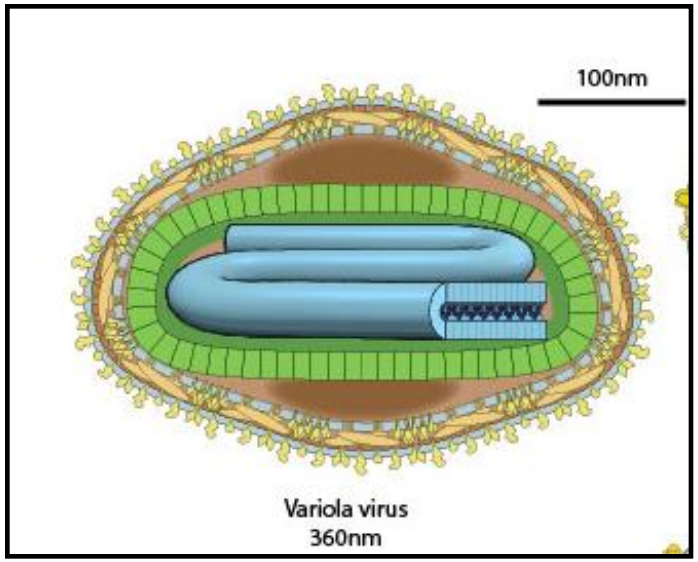
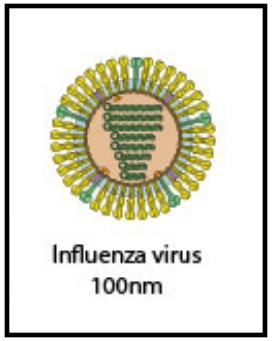
Background and historical context

- «Apoptotic gill disease» - known for 20 years
- Found virus particles EM in 1999: Poxvirus?
- 2008: Nylund *et al* poxvirus in salmon with “pox cells”

Poxvirus are LARGE and complex!



POX VIRUS



ISA VIRUS

Background and historical context

- Chordopoxvirus described in fish, reptiles, birds and mammals
- Smallpox - Variola: poxvirus specific to humans
- Poxvirus in fish:
  - Koi carp, Ayu and Atlantic salmon – all farmed fish
  - Affinity to the gills

- In 2015 the first fish poxvirus genom was published
  - Salmon gill poxvirus disease (SGPVD) «salpox disease»
  - Diagnostic PCR made
  - SGPV: compromises the immune system / gill epithelial integrity

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Salmon Gill Poxvirus, the Deepest Representative of the *Chordopoxvirinae*

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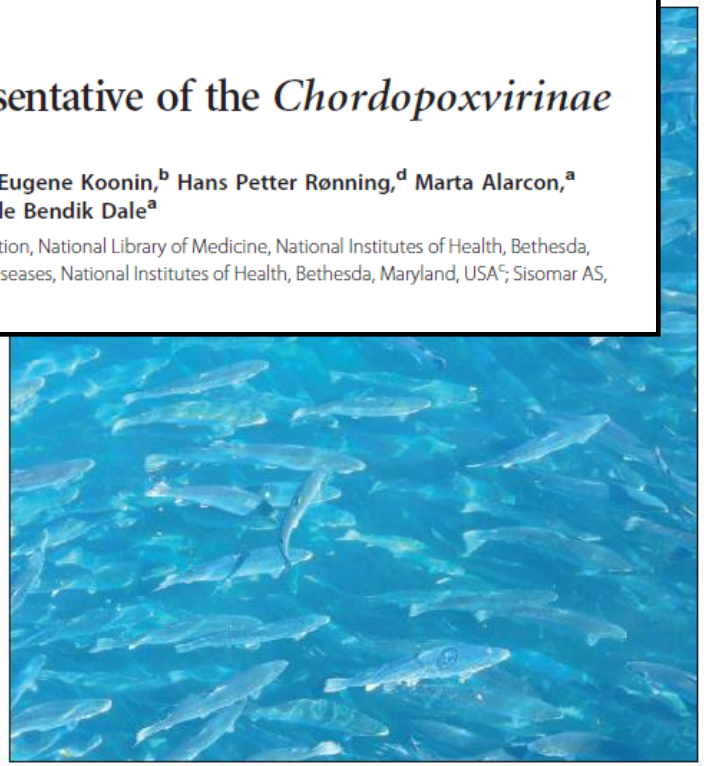

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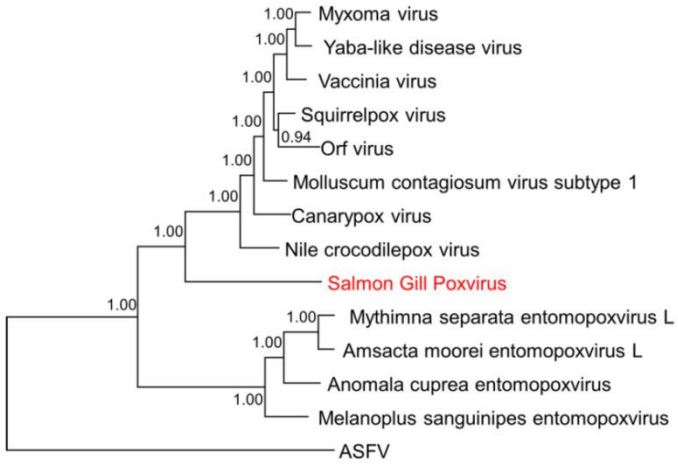
Highlights – genome SPGV – 204 genes:

- Deepest branch of chordopoxvirus:
  - coevolution with the host
- Chordopox genes required for genome replication and expression present
- Missing: genes involved in membrane biogenesis
  - i.e not infectious to tetrapods?
- Numerous novel genes encoding proteins with unknown function
- Immune suppression genes



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Outbreak in smolt farm, «clean cut» case of the familiar type

- Acute
- Spreading
- Morbidity high
- Mortality vary- sometimes very high
- Lethargic fish with respiratory distress
- Recurrent in many farms
- Stop feeding, increase oxygen supply, avoid stress!!!
- Few autopsy findings; empty gut, pale gills

«Clean-cut» case: Premortality stage

- No lesions on autopsy, empty gut
- PCR positive in all fish
- Histopathology: apoptotic cells in the gills of all fish, but little respiratory obstruction

TABLE 2 Overview of results

Clinical stage	No. of fish	Median (range) C_T value for poxvirus in gills by qPCR	% of fish with: IHC of gills	% of fish with: Hemophagocytosis
Premortality	20	18.1 (15.8–22.4)	95	0
Mortality	60	20.5 (15.7–28.9)	91.4[a]	66.7
Postmortality	10	24.7 (18.9–30.7)	20	20

[a] Two dead fish were not suited for IHC because of autolysis.

«Clean-cut» case: Mortality stage

- Histopathology:
  - Obstructive gill lesions with apoptotic cells
  - extensive hemophagocytosis in spleen / kidney

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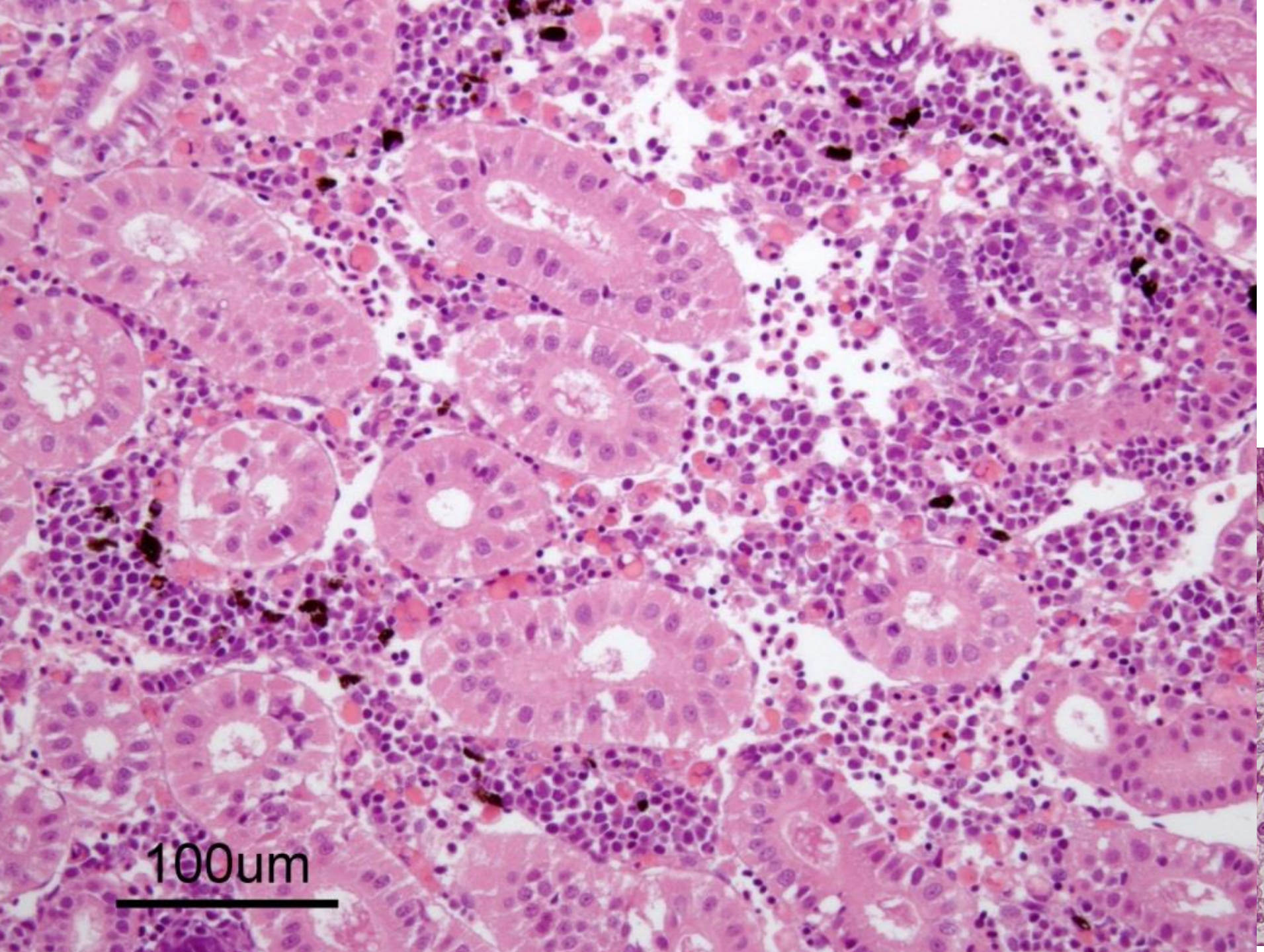
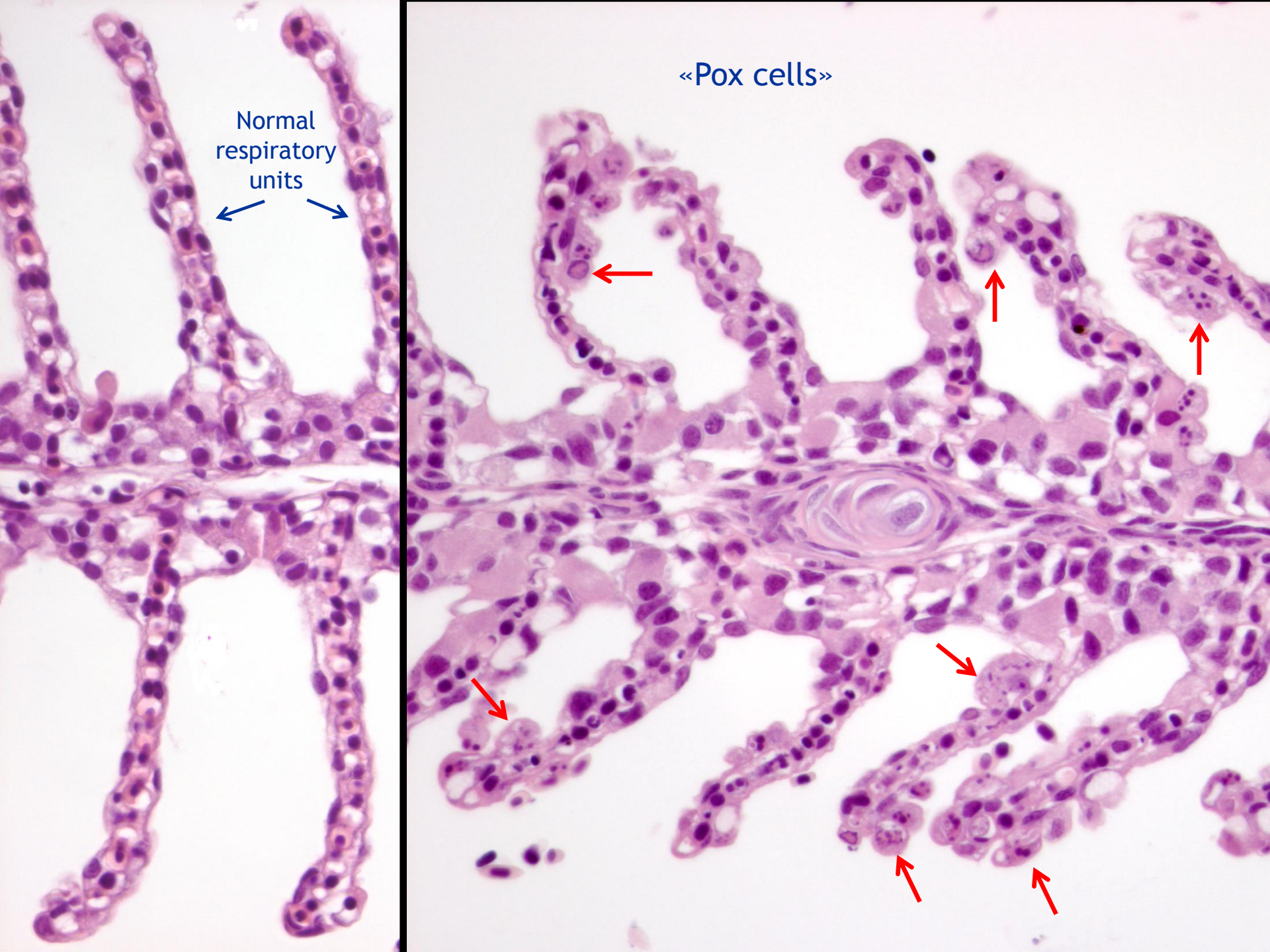
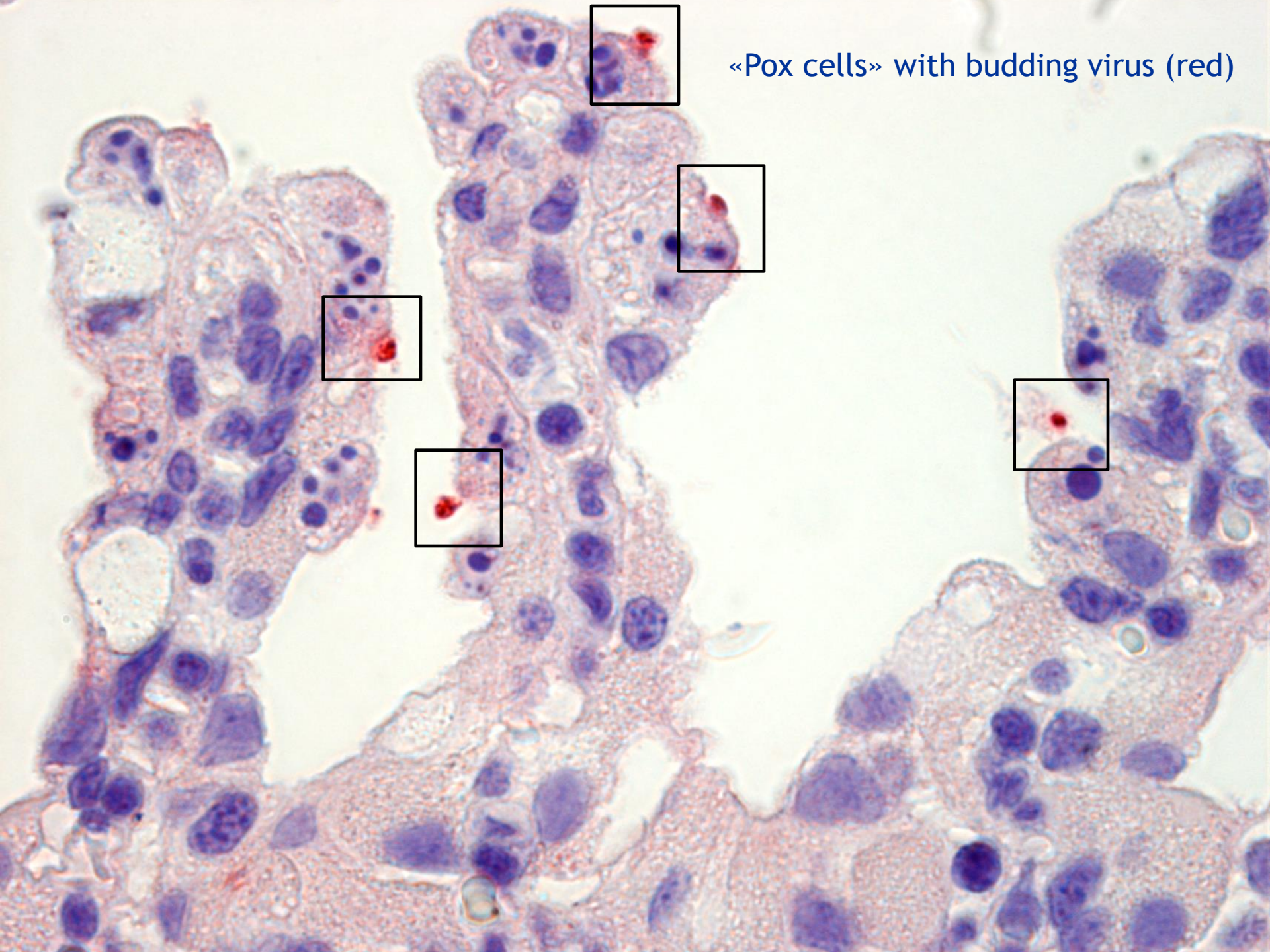

100um


Normal
respiratory
units
«Pox cells»


«Pox cells» with budding virus (red)

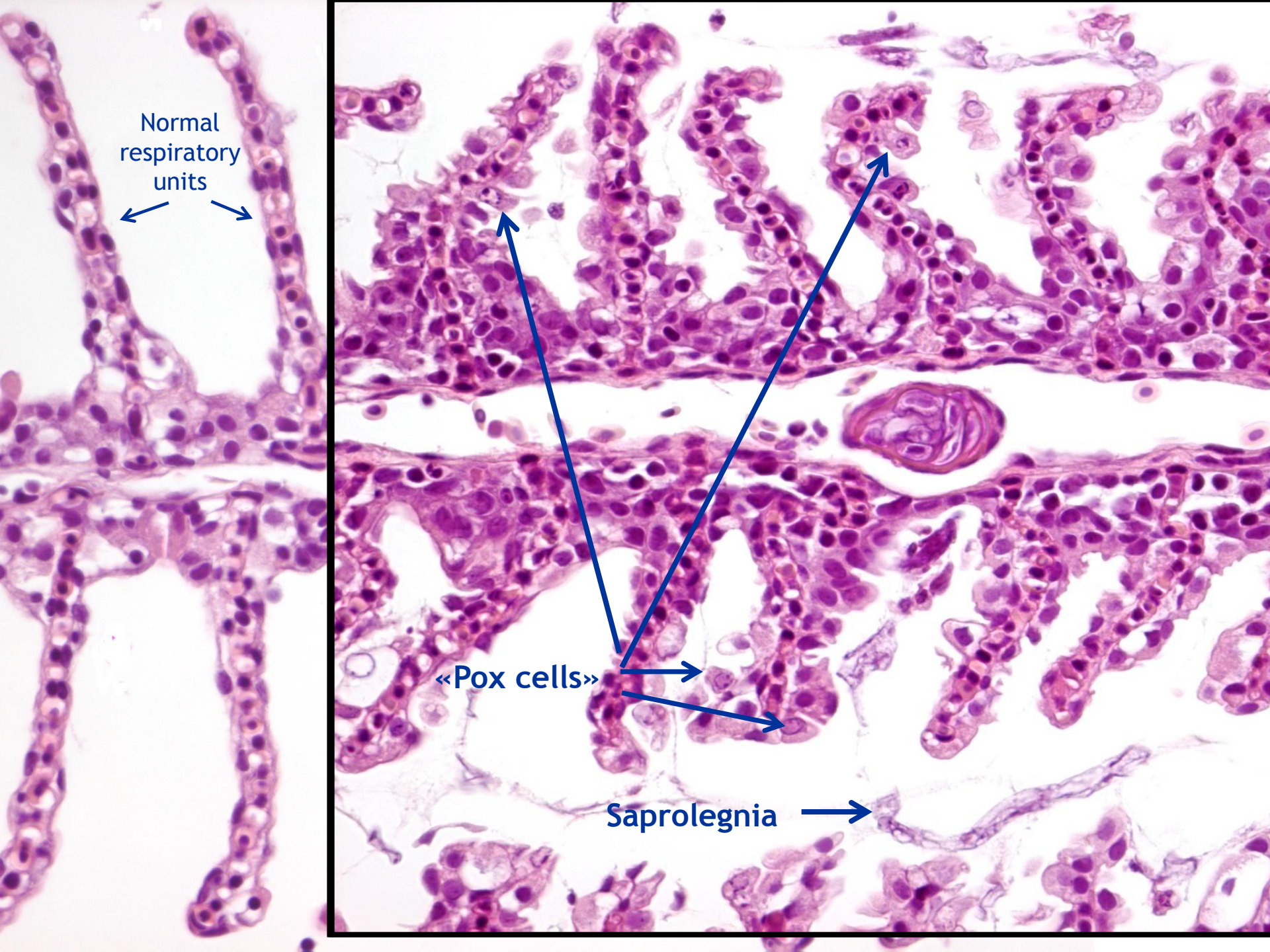
Recent experiences: «complex» cases revealed by improved diagnostic tools

- Complex pathology + wide/variable range of additional gill pathogens/opportunistic agents
- These «other» agents easy to see in microscope and too quickly given all the blame for the disease:
- The signs of SPGV: overlooked - or not looked for - in the midst of very obvious, other findings

-> PCR: efficient way to check if SPGV is present

«Complex» case, freshwater farm

- «Clean cut» salpox disease diagnosed 4 months previous to this outbreak
- Loss of apetite, increased mortality
- Fish were in smoltification|
- Slightly pale gills, white-brownish patches suggesting fungal infection
- Fungal infection confirmed


Normal
respiratory
units
«Pox cells»
Saprolegnia

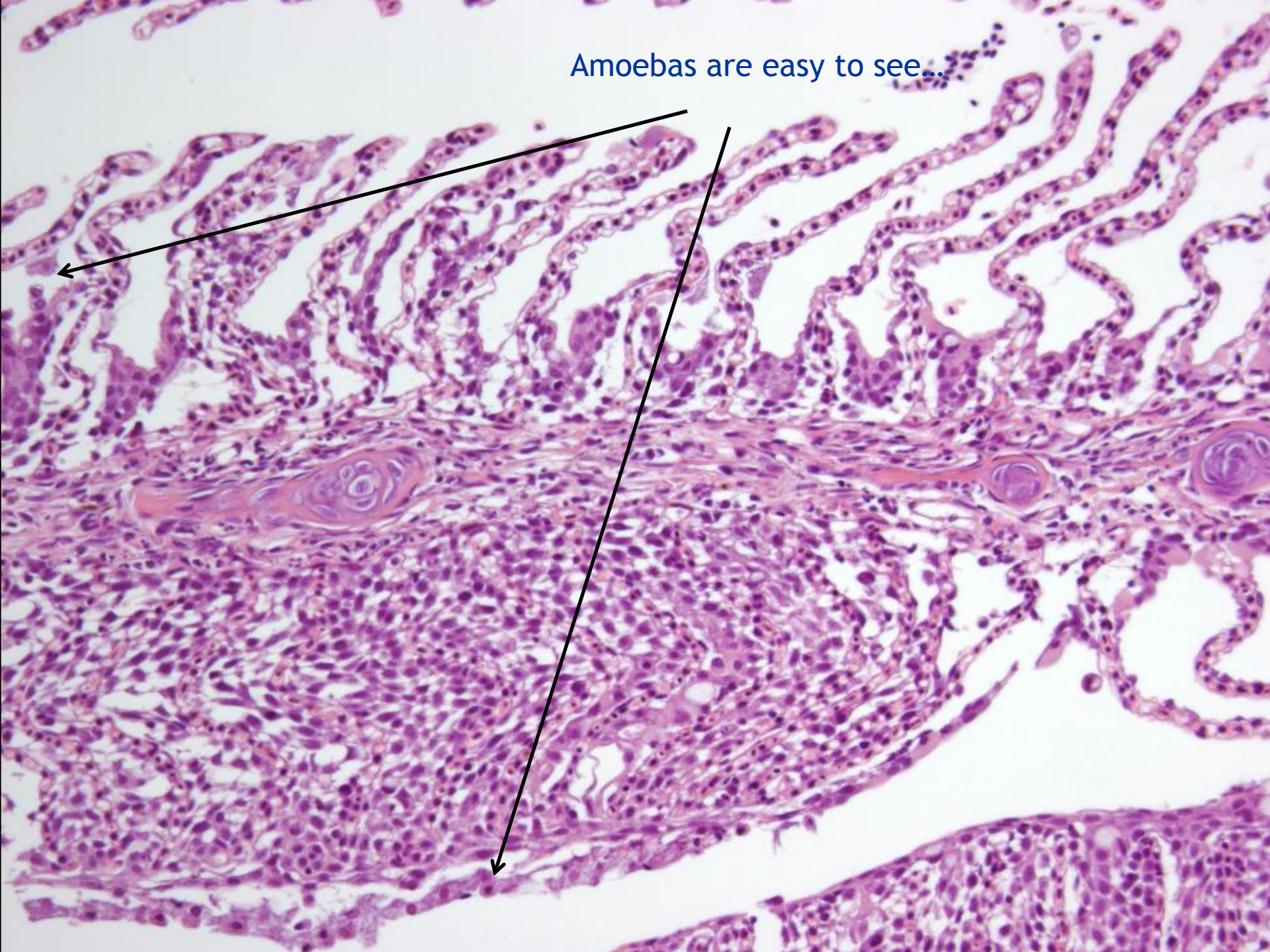
Experiences of manifestations in «complex» cases, sea farm: AGD revisited….

First cases of amoebic gill disease (AGD) in Norwegian seawater farmed Atlantic salmon, *Salmo salar* L., and phylogeny of the causative amoeba using 18S cDNA sequences

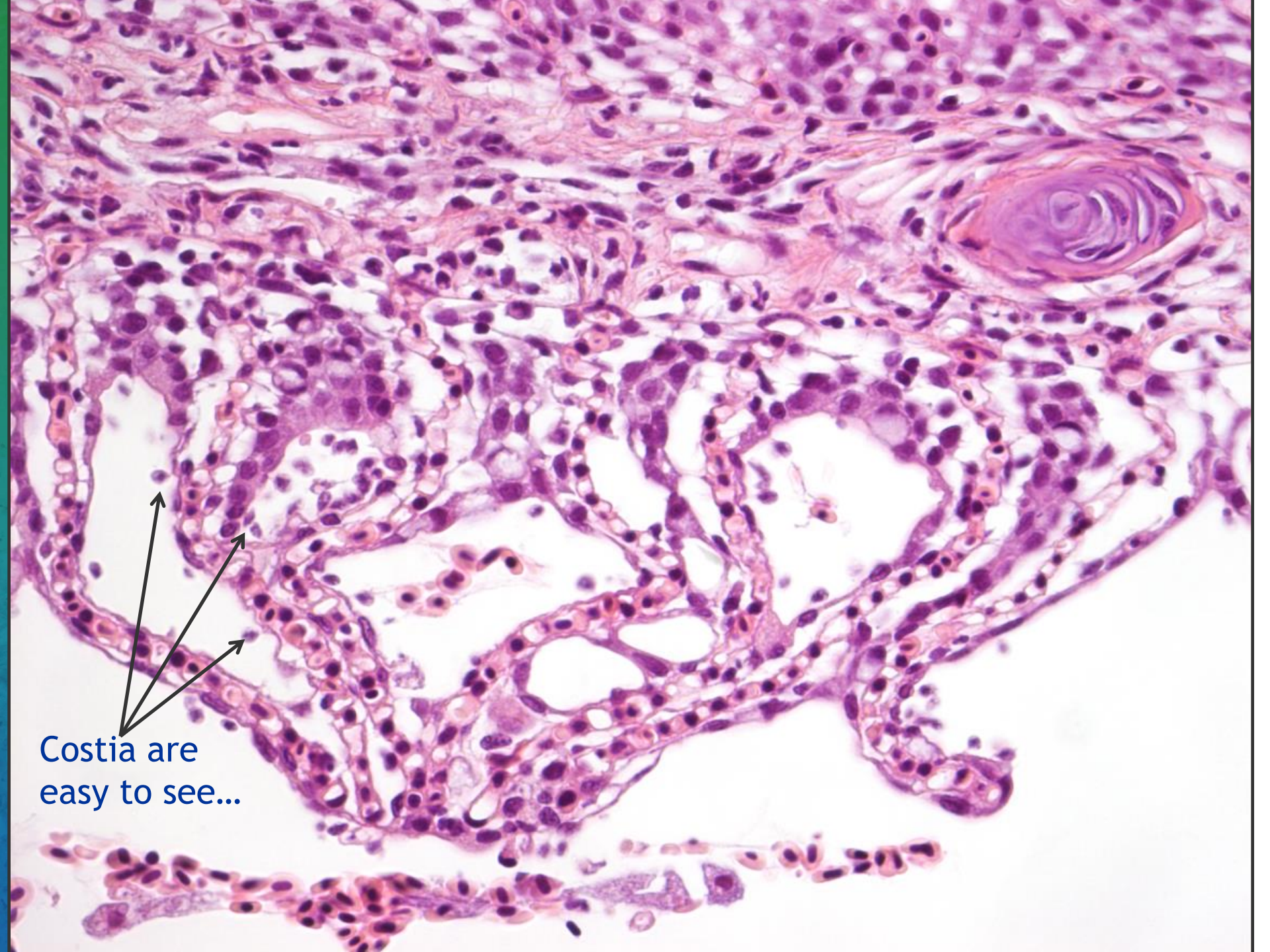
T Steinum[1], A Kvellestad[1], L B Rønneberg[2], H Nilsen[3], A Asheim[4], K Fjell[5], S M R Nygård[6], A B Olsen[3] and O B Dale[1]

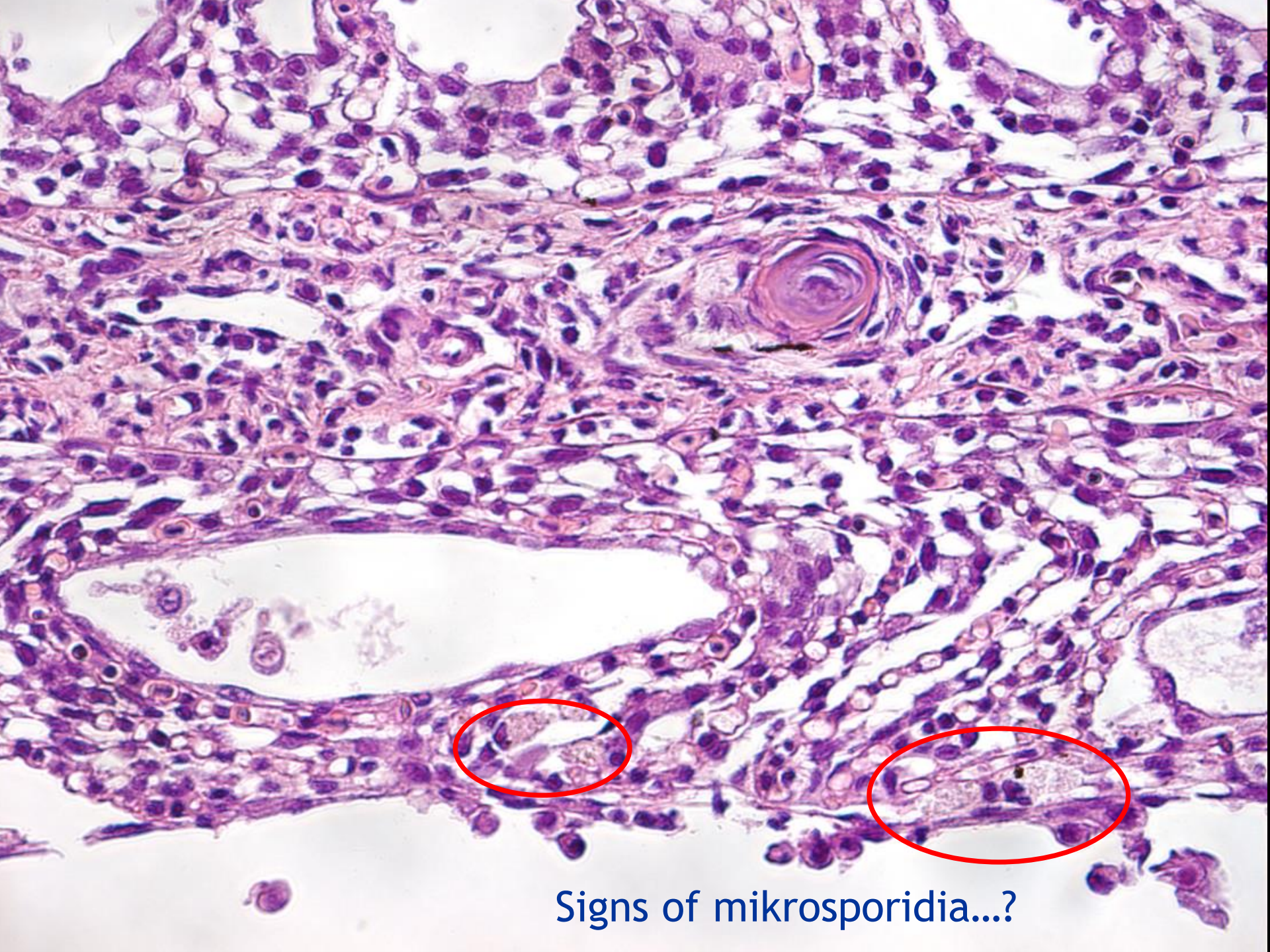
1 National Veterinary Institute, Oslo, Norway
2 Fiske-Liv A/S, Ålesund, Norway
3 National Veterinary Institute, Bergen, Norway
4 AkvaVet Gulen AS, Gulen, Norway
5 Bioserve A/S, Stavanger, Norway
6 Fish Health and Environment Company, Haugesund, Norway

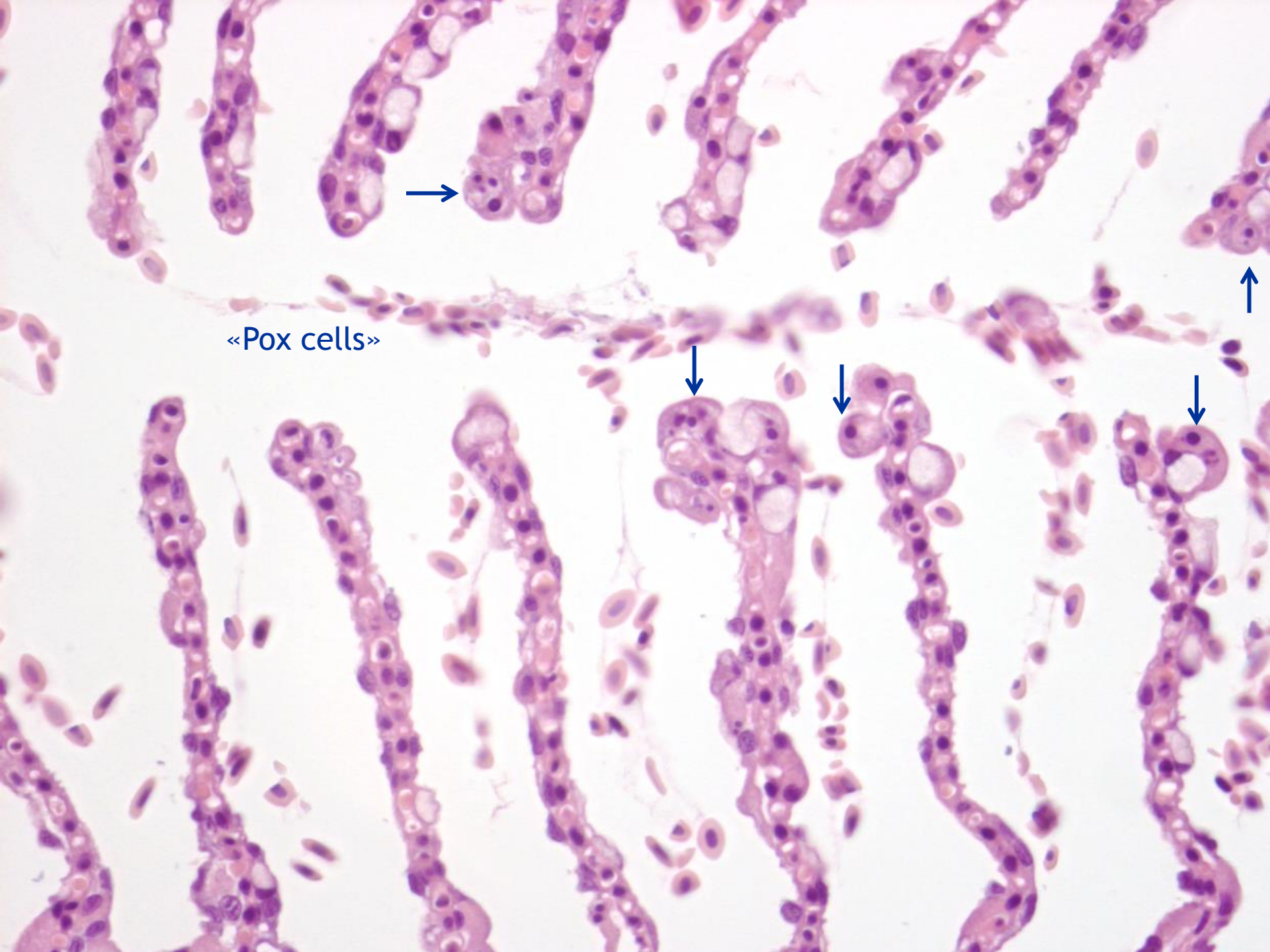
J.Fish.dis 2008


Amoebas are easy to see…


Epiteliocysts are easy to see…


Costia are
easy to see…


Signs of mikrosporidia…?


«Pox cells»

IHC of SPGV budding from apoptotic cells and amoeba on apoptotic cell

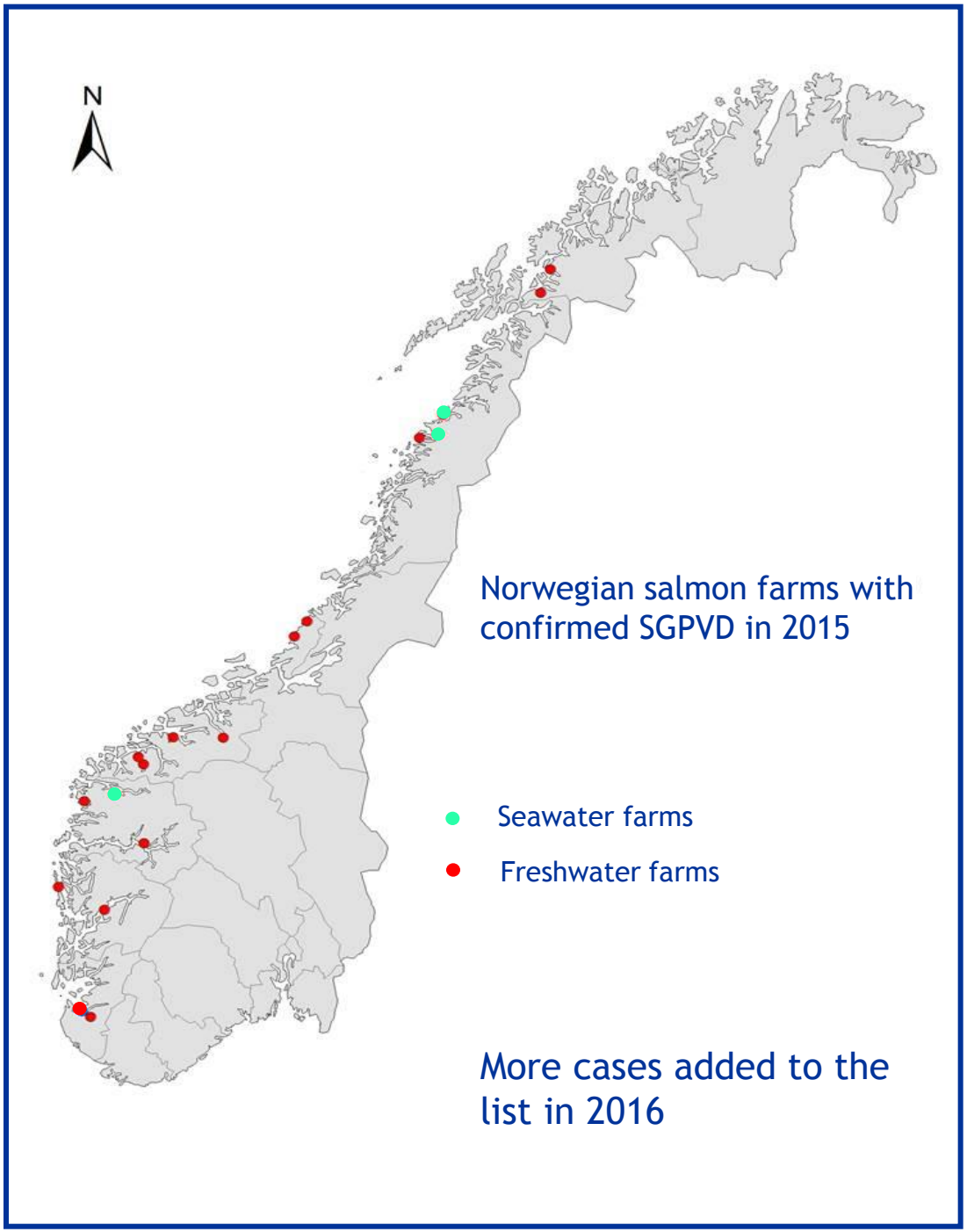
What do we know about the epidemiology of salpox?

- Norwegian salmon freshwater farms
  - Farms with recirculation aquaculture system
  - Farms with flow through systems
  - Farms with seawater added
  - Farms without seawater added
- Present in Norwegian Atlantic salmon seawater farms

- Faeroe Islands - Atlantic salmon freshwater farms
  - In 2015 a transmission study in a Faroese farm (Nolsøe)
- Scotland: Hamish Rodger recently presented cases

- The origin, reservoirs, host range and dissemination of SPGV – unknown

- Our knowledge is based on studies of spontaneous outbreaks



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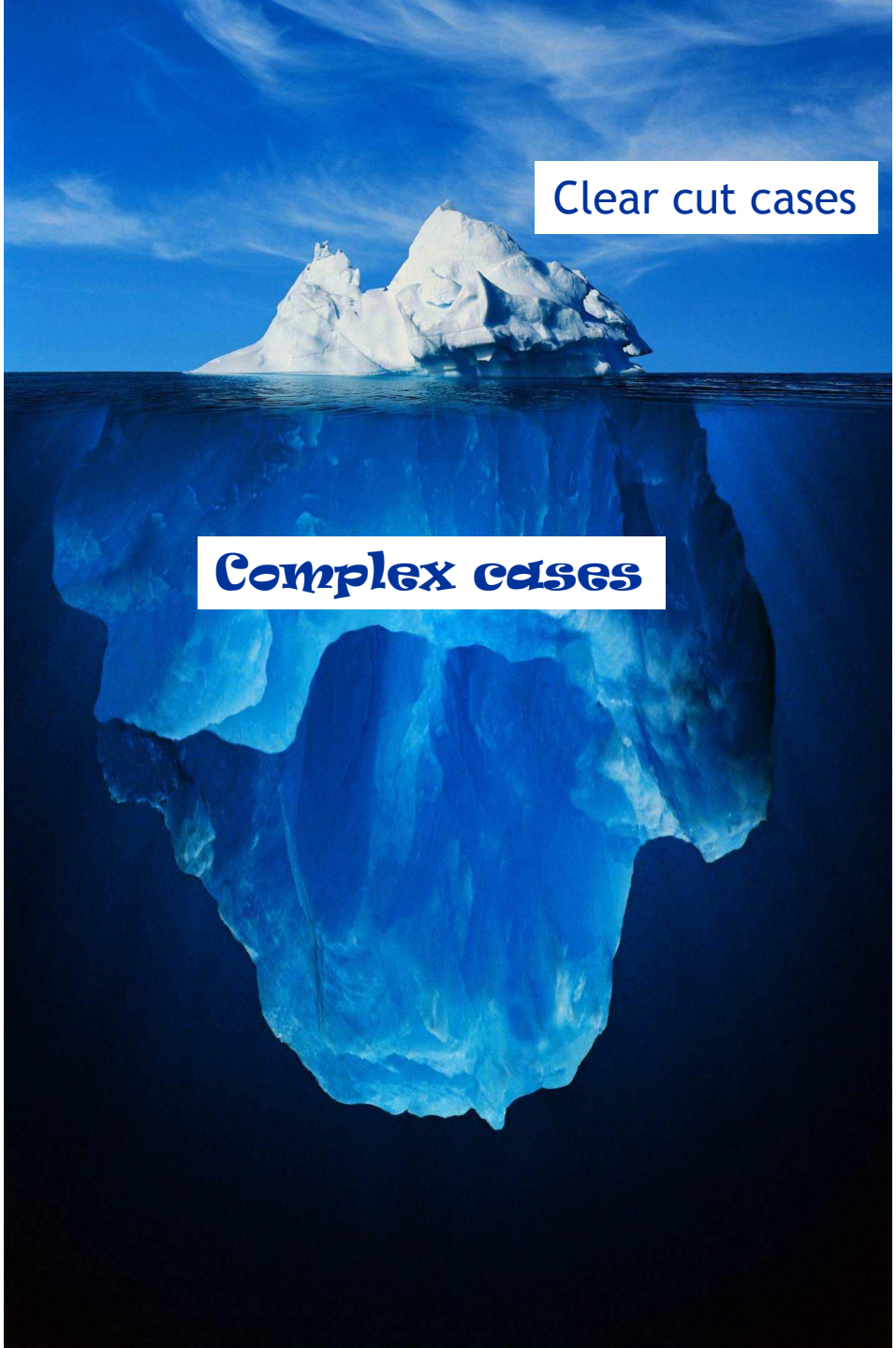
The emerging picture:

- Severe mortality occur
- The clear-cut cases:
  in farms with no other agents causing additional problems ?
- Complex cases with «hidden» SPGV:
  in farms with other gill pathogens / opportunists ?
  - Epithelial damage (apoptosis) and interference with host immunity weakens defence against any, other pathogenic/opportunistic agent present ?


Clear cut cases
Complex cases

Thanks to

- Fish health services
- Marine Harvest
- All colleges at NVI
- The Research Council of Norway

Tetrapod fish!

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