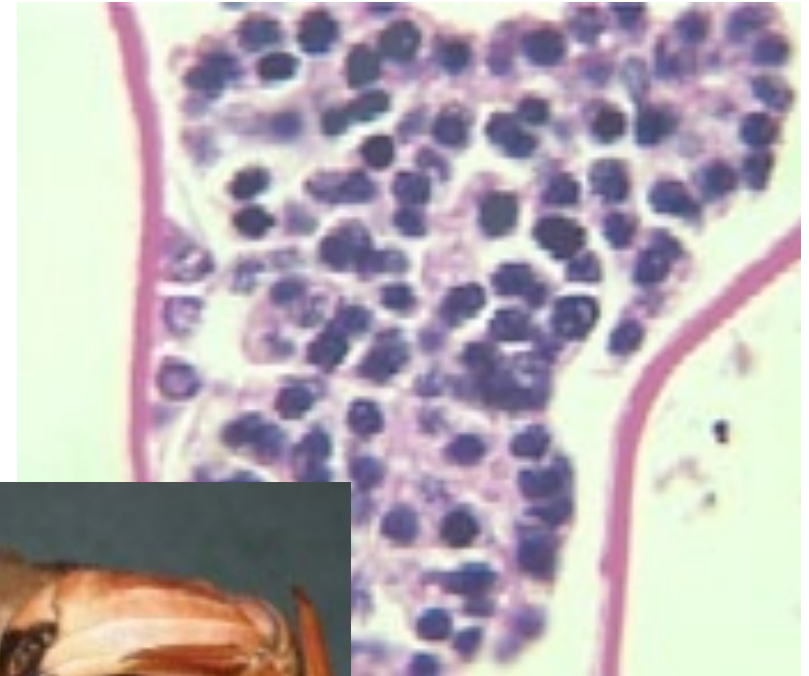


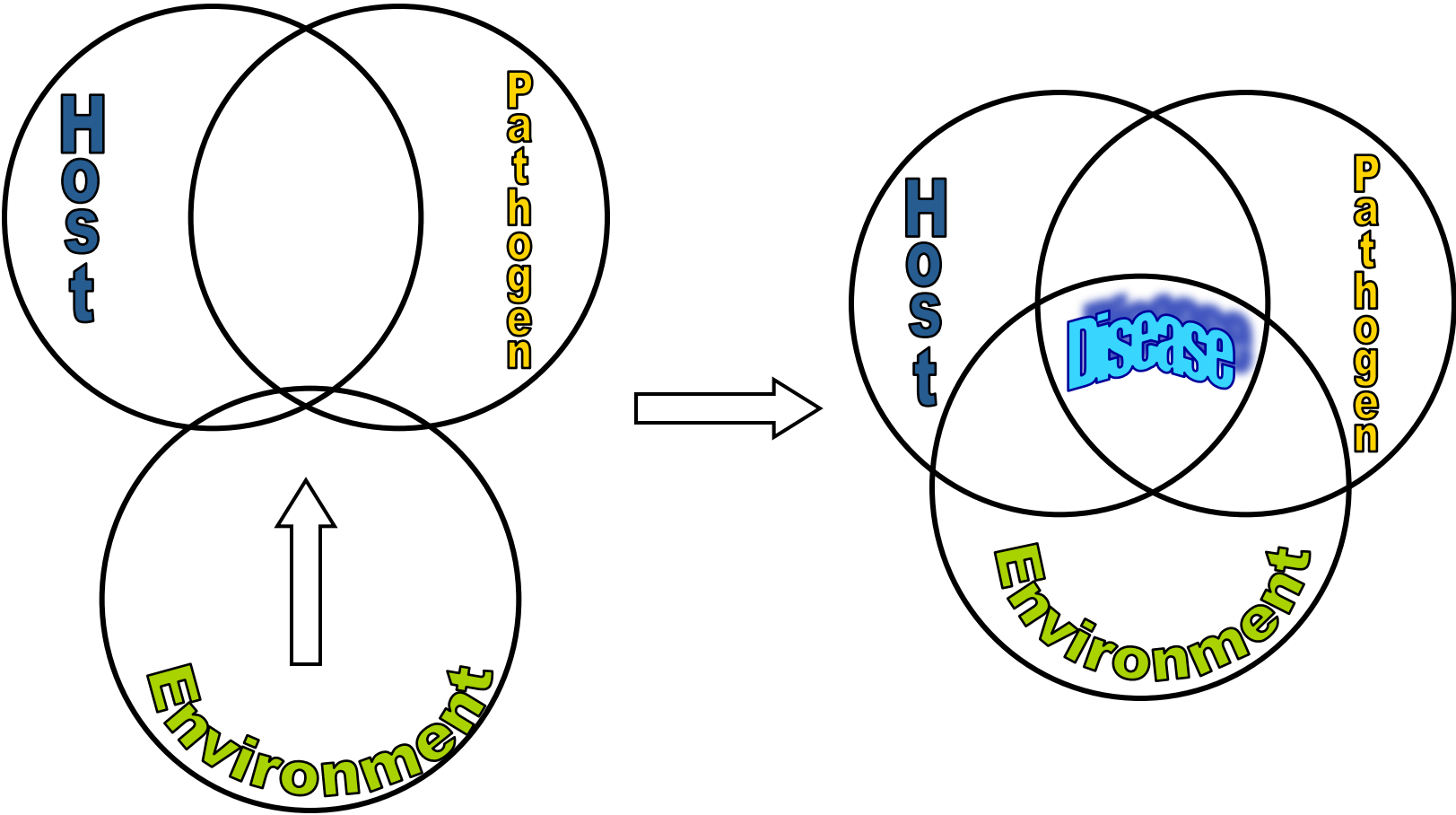
# Shellfish Parasites & Pathogens



# Definitions

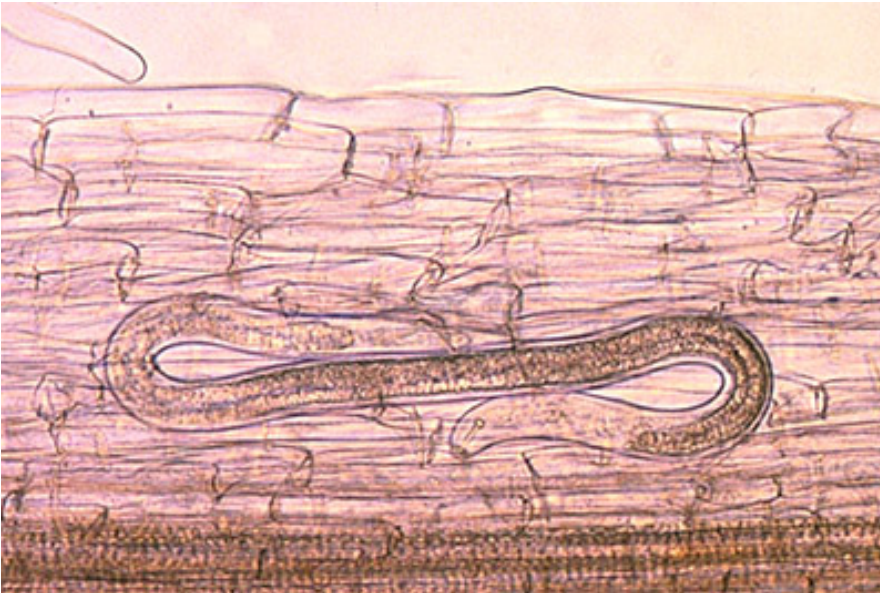
- **Disease**: an alteration from the normal state
- **Parasite**: an organism that is metabolically dependent on its host (gets its energy or food from its host)
- **Infectious**: transmissible (e.g. virus, bacteria, protozoa)
- **Pathogen**: an organism that is able to cause disease. Parasites, under certain conditions, may cause disease.
- **Virulence**: characteristics of the pathogen that allow it to infect, multiply and spread in or among hosts
- **Pathogenicity**: the ability to cause disease within a host
- ***Presence of a parasite does not equate to presence of a disease***

# Development of disease



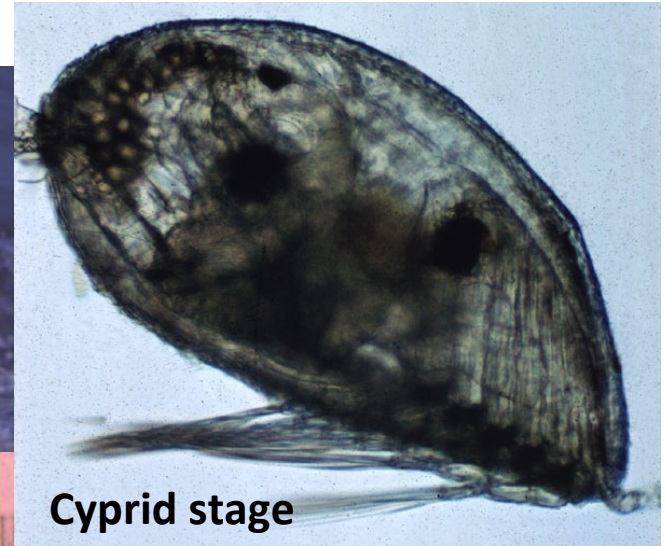
# What is a Parasite?

- Ectoparasite
- Endoparasite

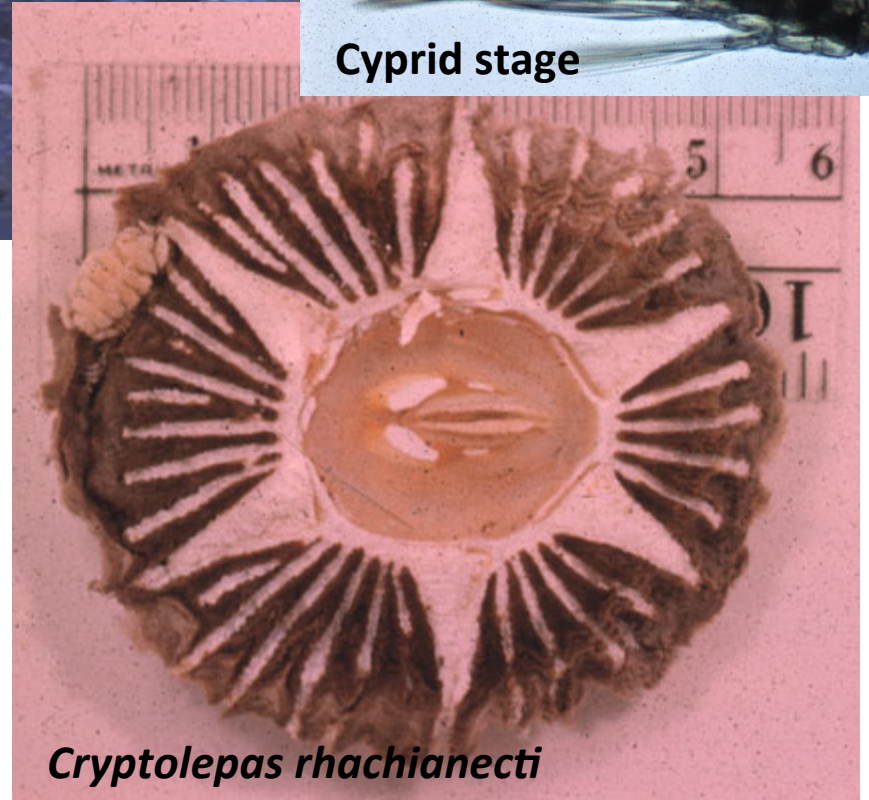


*Cymothoa exigua*

# Whale ectoparasites



Cyprid stage



*Cryptolepas rhachianecti*

# Whale ectoparasites

Whale lice - cyamid amphipods



# Sea turtle ectoparasites



# Barnacle parasites just don't quit!



## **Rhizocephalan – decapod parasite**

- Inhibits molting
- Loses ability to reproduce
- Males gain female characteristics & appearance



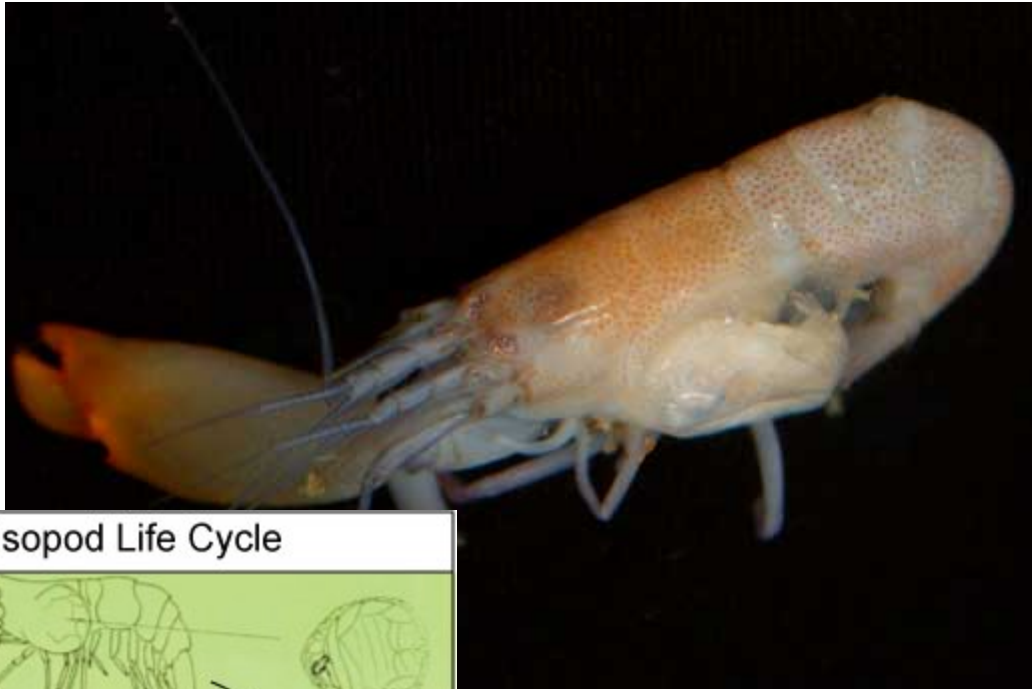
[http://www.youtube.com/watch?v=sVvK\\_eEkoK0](http://www.youtube.com/watch?v=sVvK_eEkoK0)

# Bopyrid Isopod

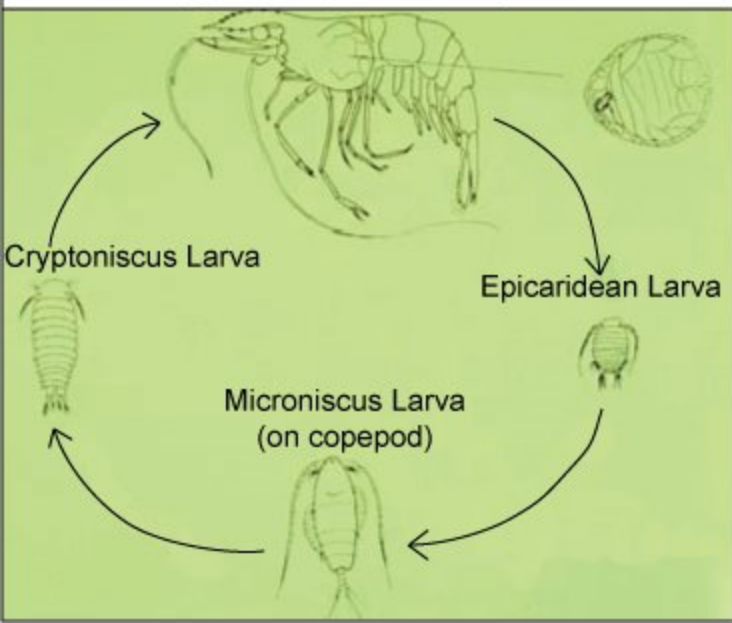


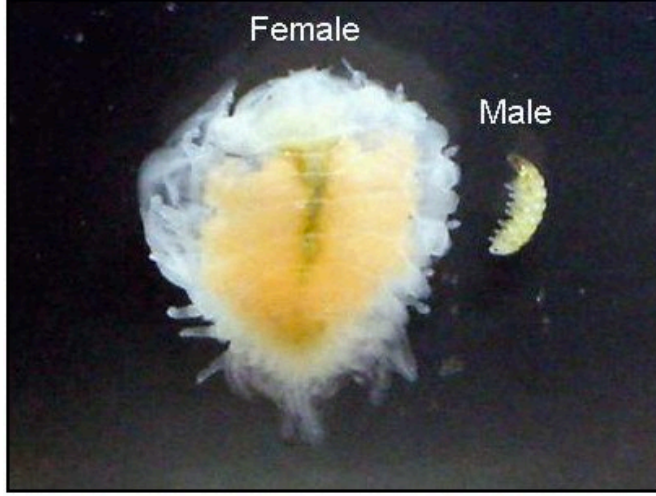
A parasitic isopod (Peracarida: Isopoda: Epicaridea: Bopyridae) inducing and inhabiting a blister under the carapace of the brown grass shrimp, *Leander tenuicornis* (Decapoda: Caridea: Palaemonidae).

# Bopyrid Isopod

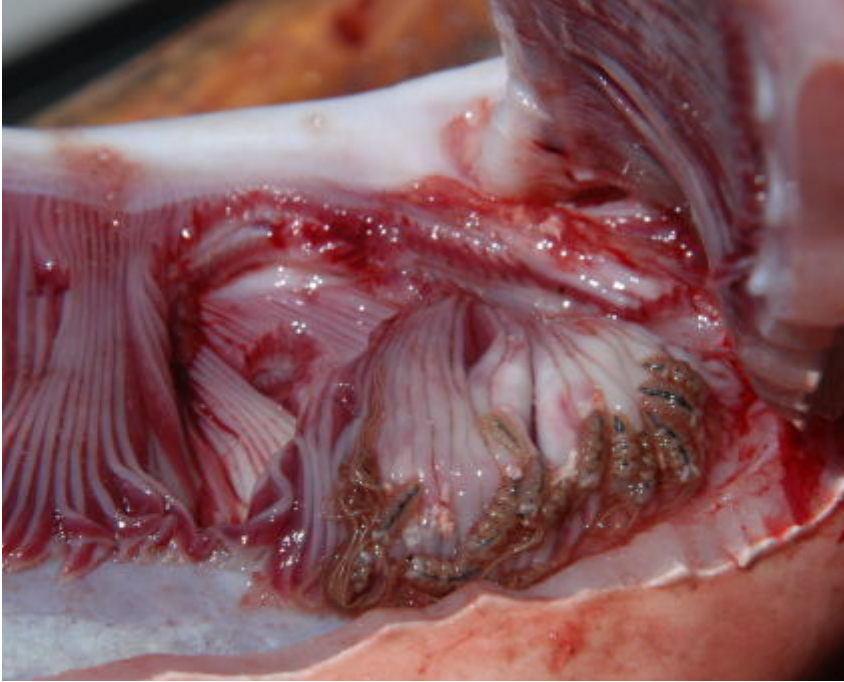


Bopyrid Isopod Life Cycle



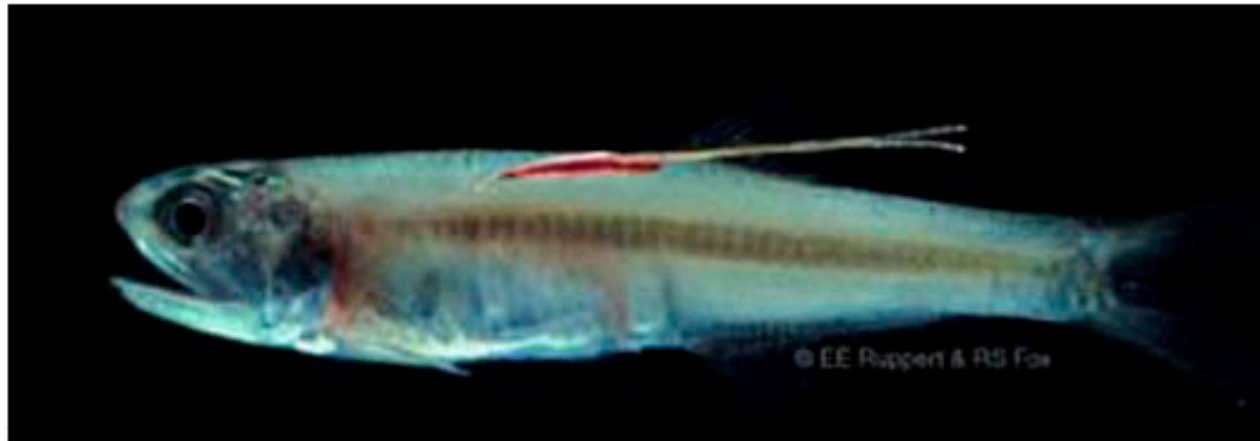


# Parasitic copepods



- 1,700 species infecting fish
- Some share many morphological adaptations of free-living counterparts (ie: sea lice)
- Others permanently anchored; penetrate deep into host tissue. Jointed appendages and external segmentation greatly reduced





The parasitic copepod *Lernaeenicus radiatus* (Copepoda: Siphonostomatoida: Pennellidae) on an anchovy.

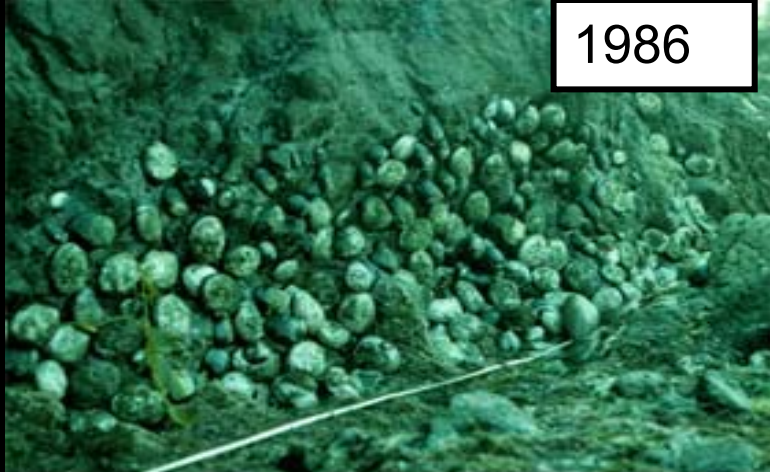


# Withering Syndrome



Chronic wasting disease – symptoms include:  
weakness, lethargy, diminished pedal mass, mantle retraction, poor gonadal development, and DEATH

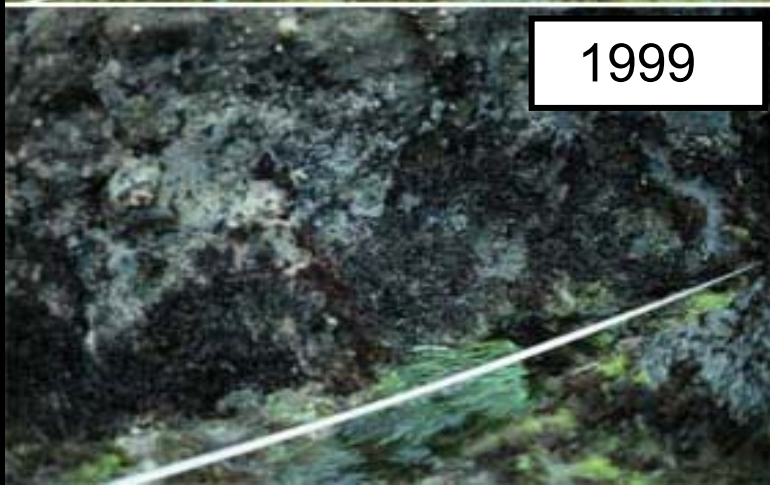
1986



1988



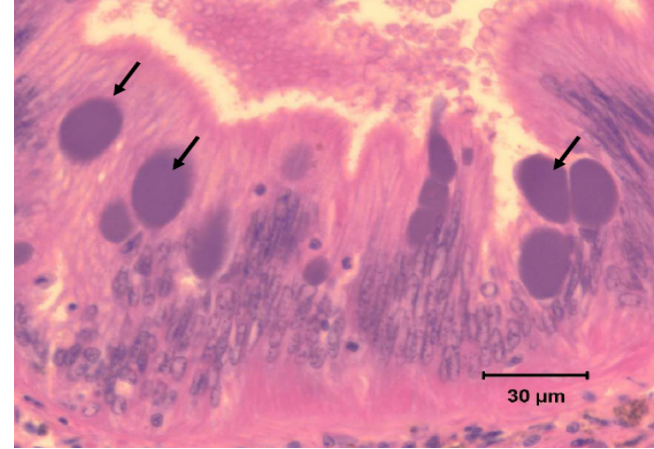
1999



on Channel Islands  
es due to WS

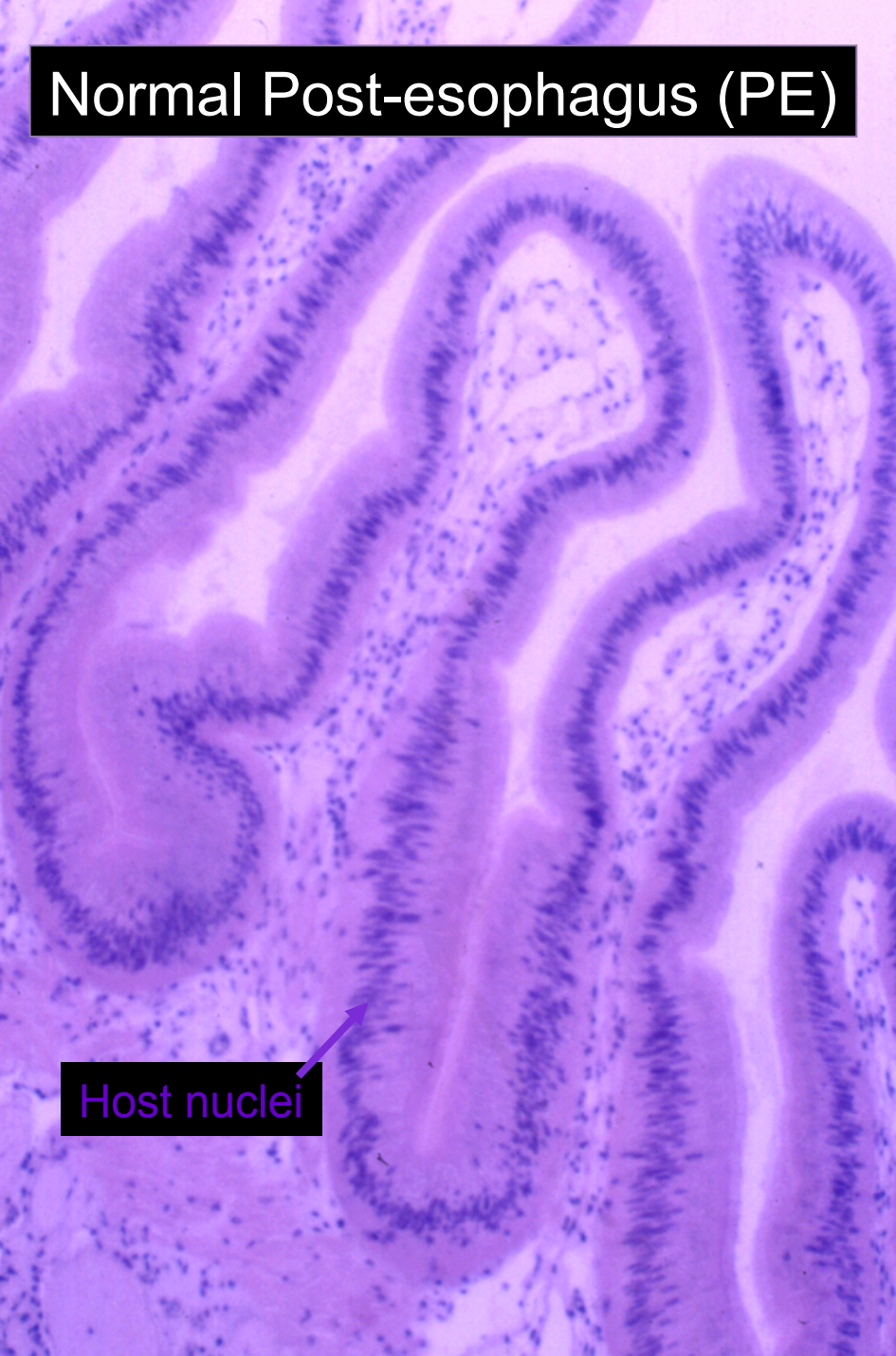




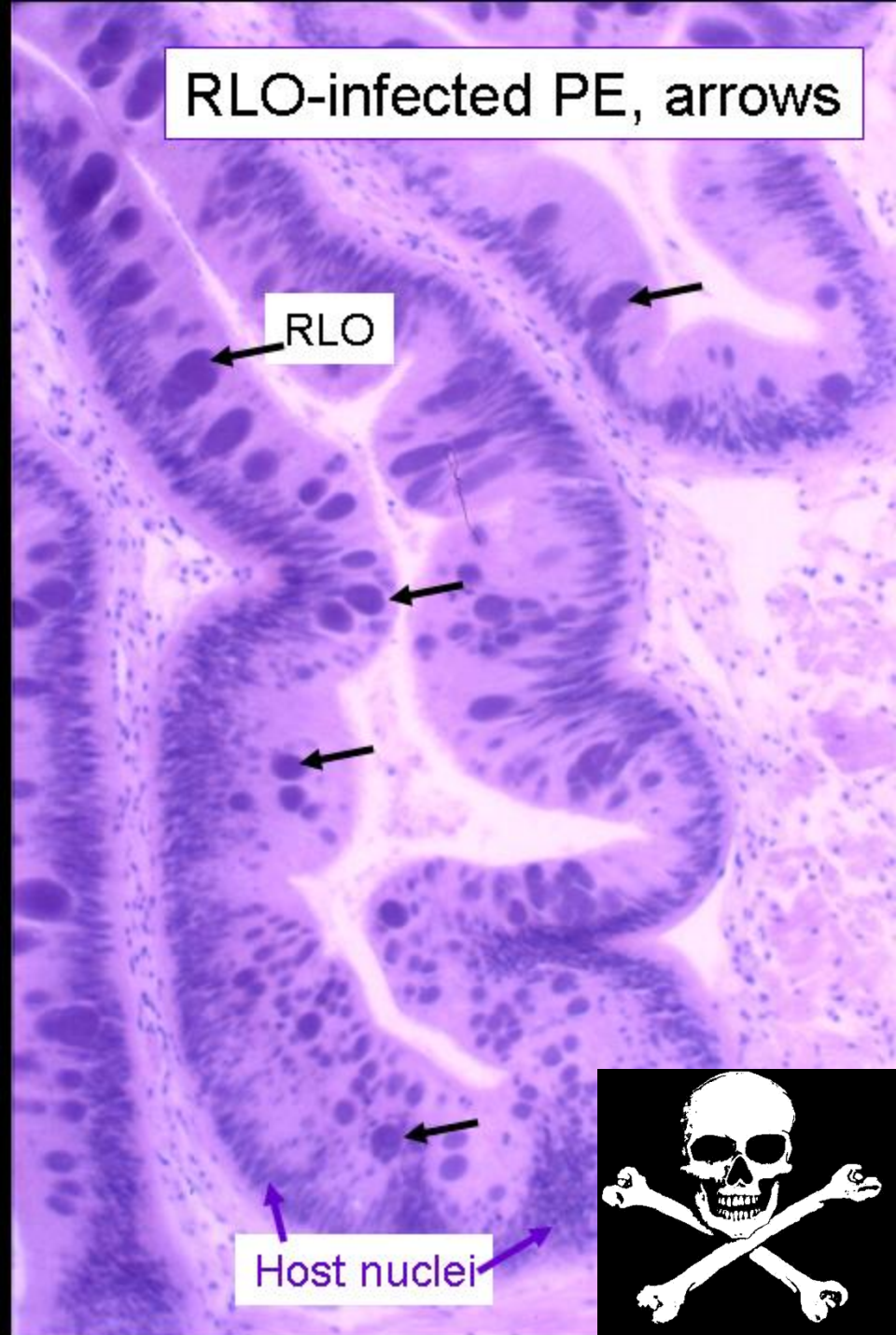


- WS caused by a rickettsiales-like organism (RLO)
  - Etiological agent: “*Candidatus Xenohalotis californiensis*”
  - Intracellular bacteria infects the epithelial cells of the GI tract from the esophagus to the digestive gland
- Forms basophilic inclusions (large cytoplasmic bacterial colonies)
- DG metaplasia & degeneration
- Abalone catabolizes foot myofibers for energy
- All species tested to date are susceptible to infection
  - Varying degree of WS development and mortality between species

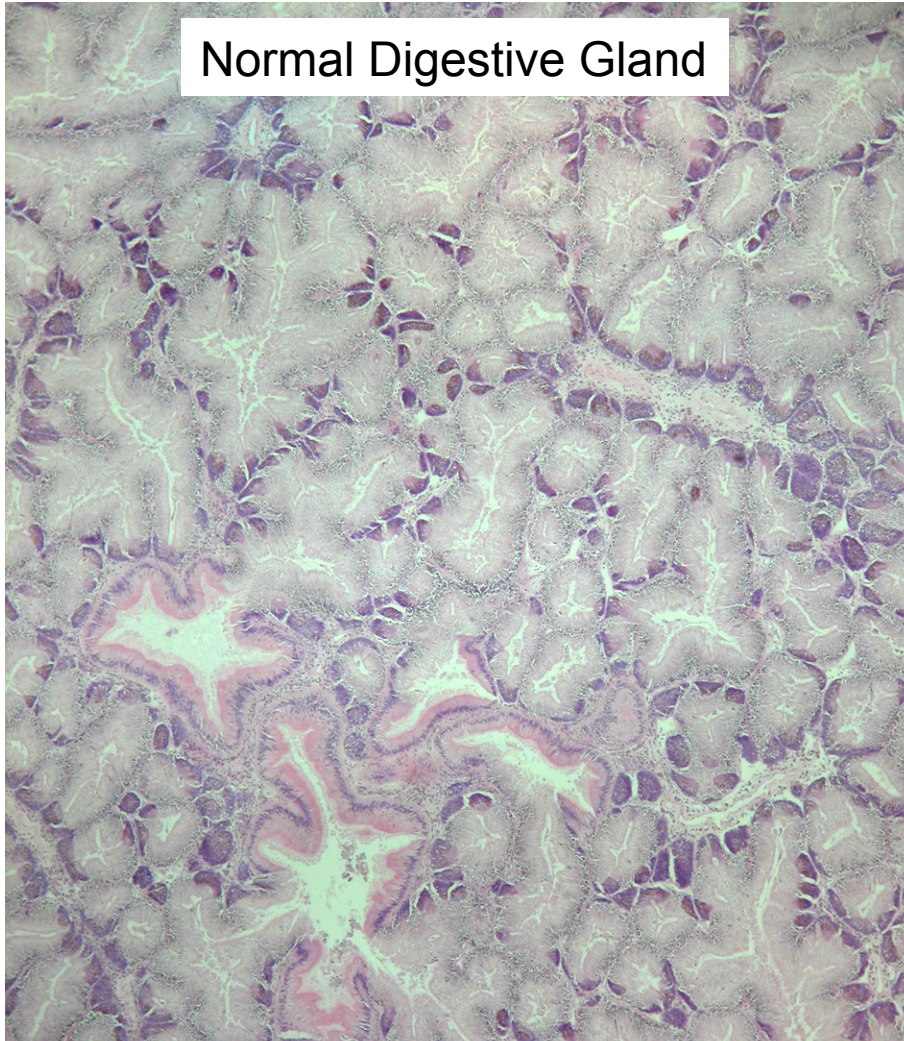
Normal Post-esophagus (PE)



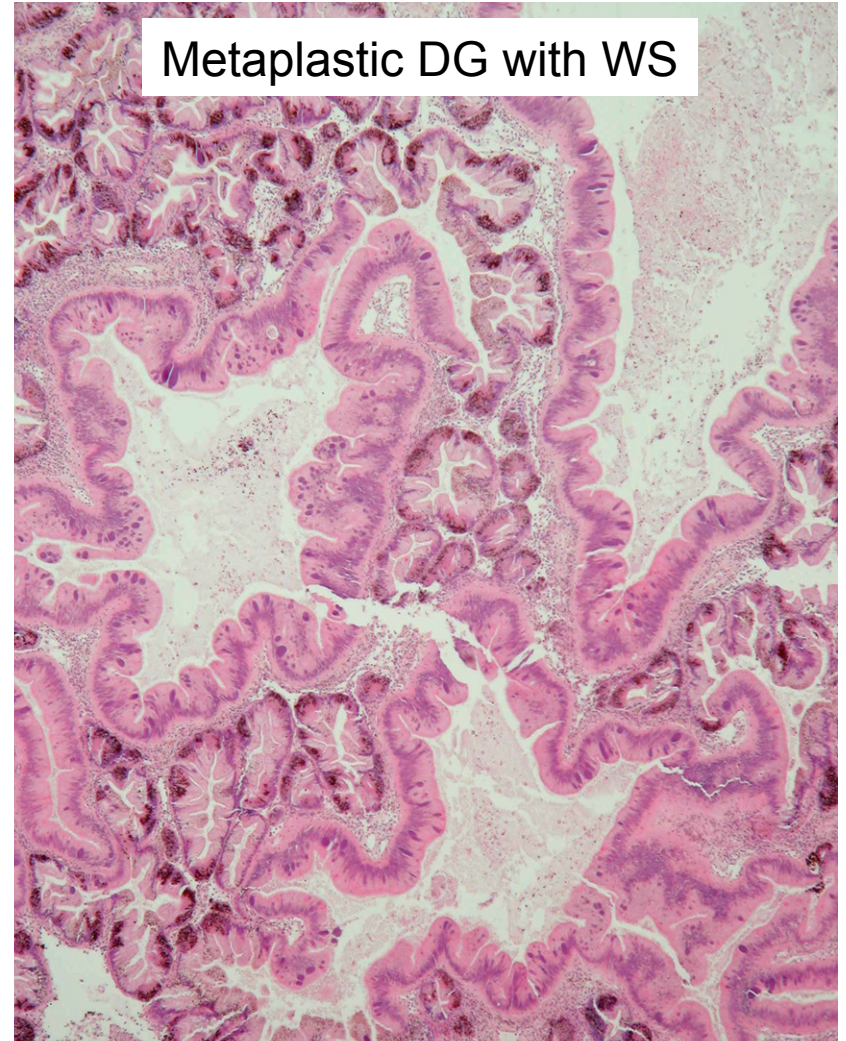
RLO-infected PE, arrows



Normal Digestive Gland



Metaplastic DG with WS



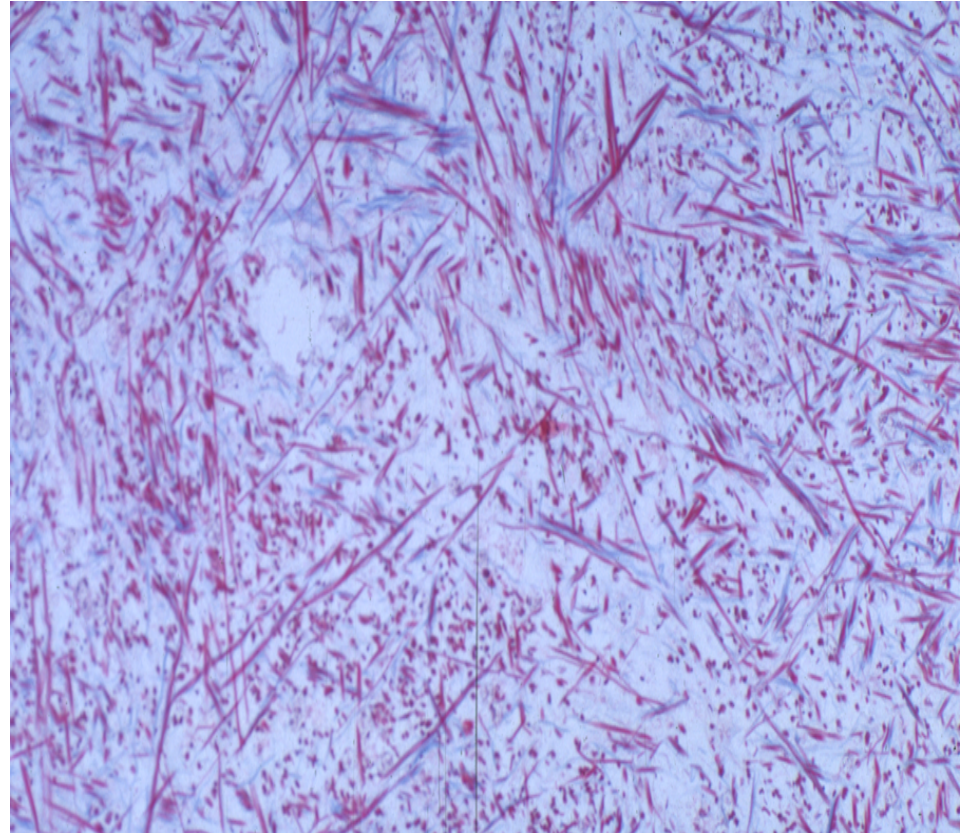
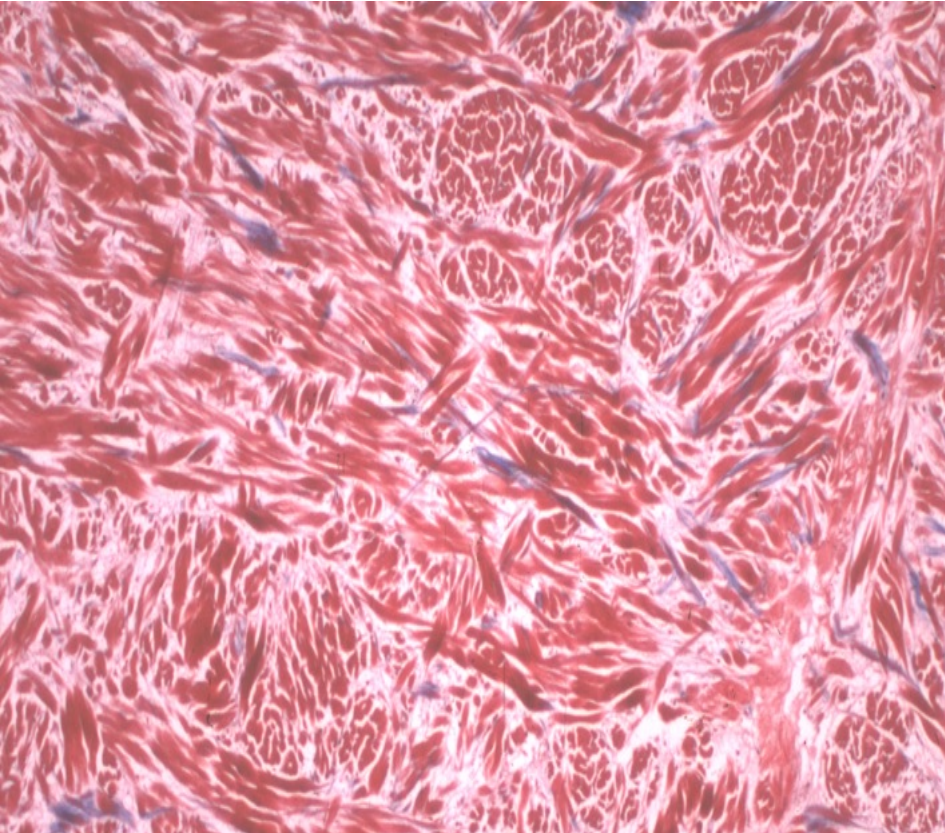
DG metaplasia (transformation of tissue as adaptive response) & degeneration (can't secrete digestive enzymes)



# Masson's Trichrome Stain

Normal

Atrophied



Catabolizes foot myofibers (glycogen and protein) for energy → atrophy



# DERMO



**Causative agent:** *Perkinsus marinus* (closely related to dinoflagellates – what phylum?)

**Species affected:**

Eastern oyster (*Crassostrea virginica*)

mussel (*Mytilus edulis*)

Pacific oyster (*Crassostrea gigas*)

sand gaper mussel (*Mya arenaria*)

Suminoe oyster (*Crassostrea ariakensis*)

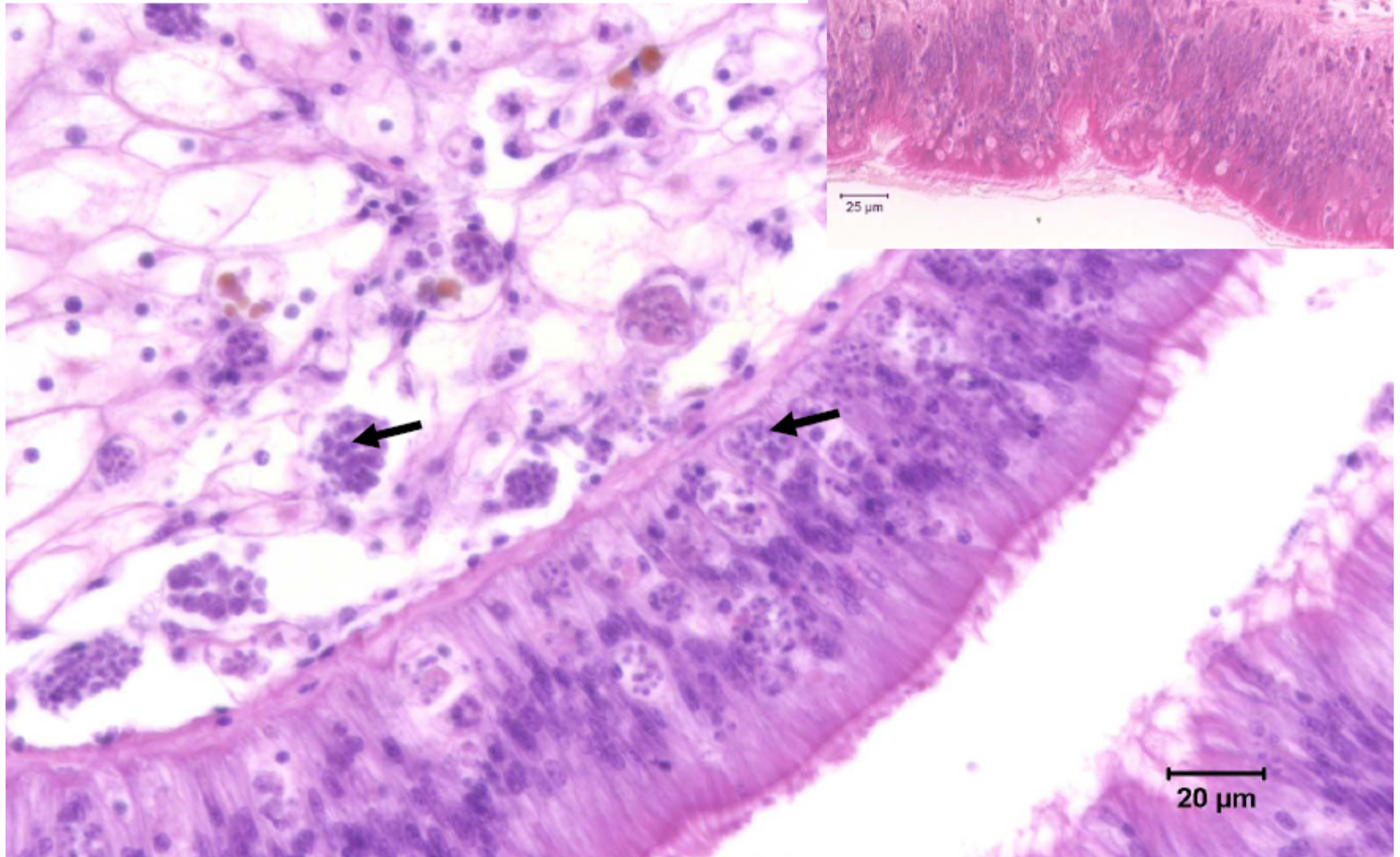
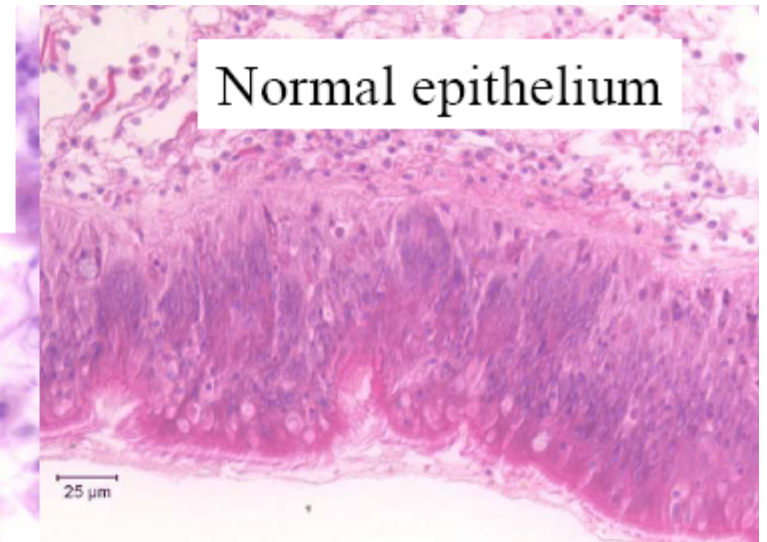
**Clinical signs:** poor condition, gaping, shrinkage of mantle, retarded growth, emaciation

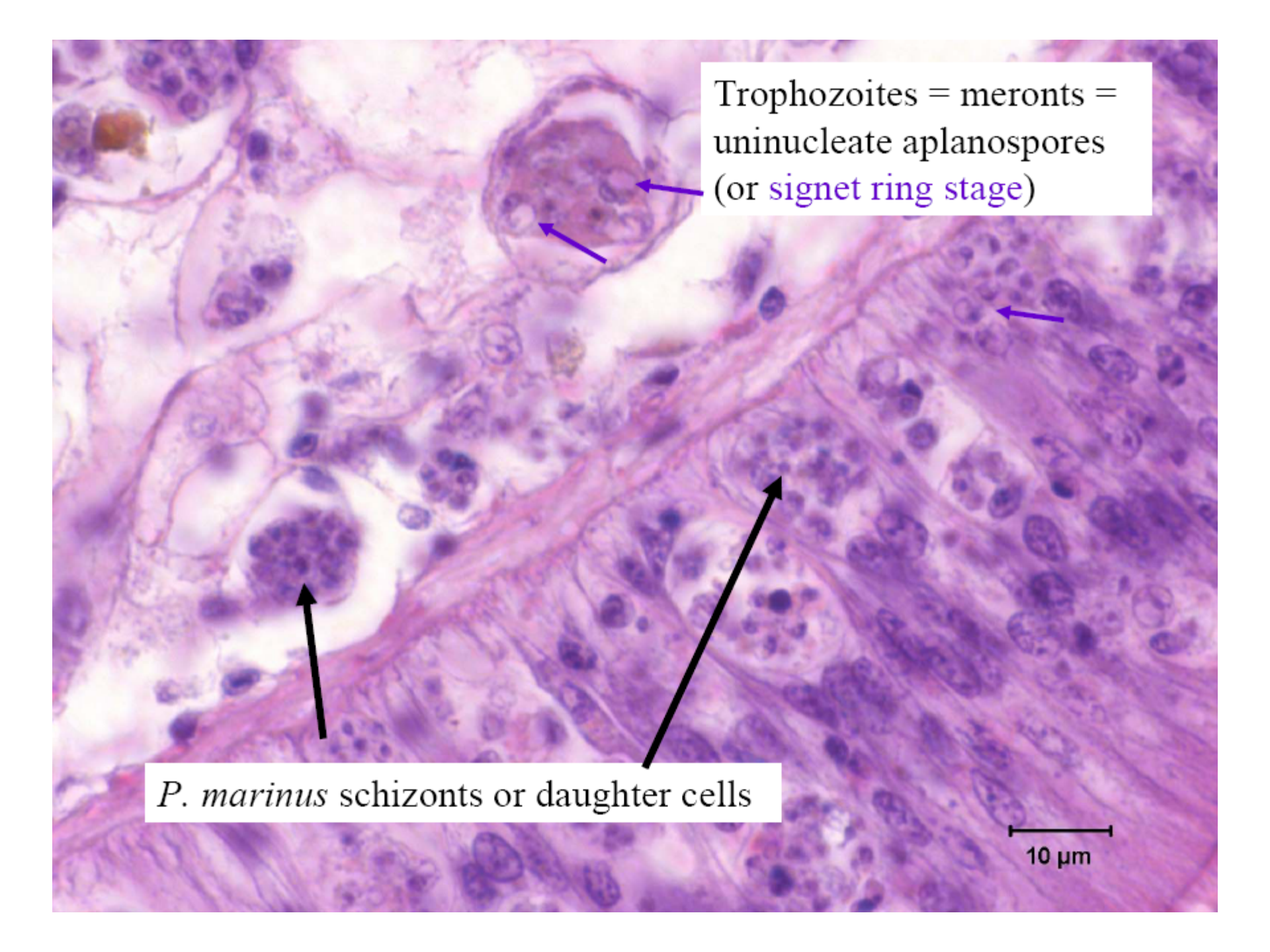
**Gross signs:** occasional pustules in soft tissue, pale digestive gland

# Dermo Epidemiology:

- Proliferation associated with warm water temperatures (>18°C) and high salinities (>12ppt)
- Suggested fecal-oral transmission
- Mortalities of up to 95% of *C. virginica* have been observed in the second summer following transfer to a disease endemic area
- Infection levels increase during spawning and under the stress of oxygen depletion
- Prevalence and intensity of infection are greatest in oysters more than one year old and at depths  $\geq 1\text{m}$
- Exposure to pollutants will increase the prevalence of infection

*Perkinsus marinus* infection in Eastern oysters (arrows). Note parasites in connective tissues and digestive epithelia





Trophozoites = meronts =  
uninucleate aplanospores  
(or signet ring stage)

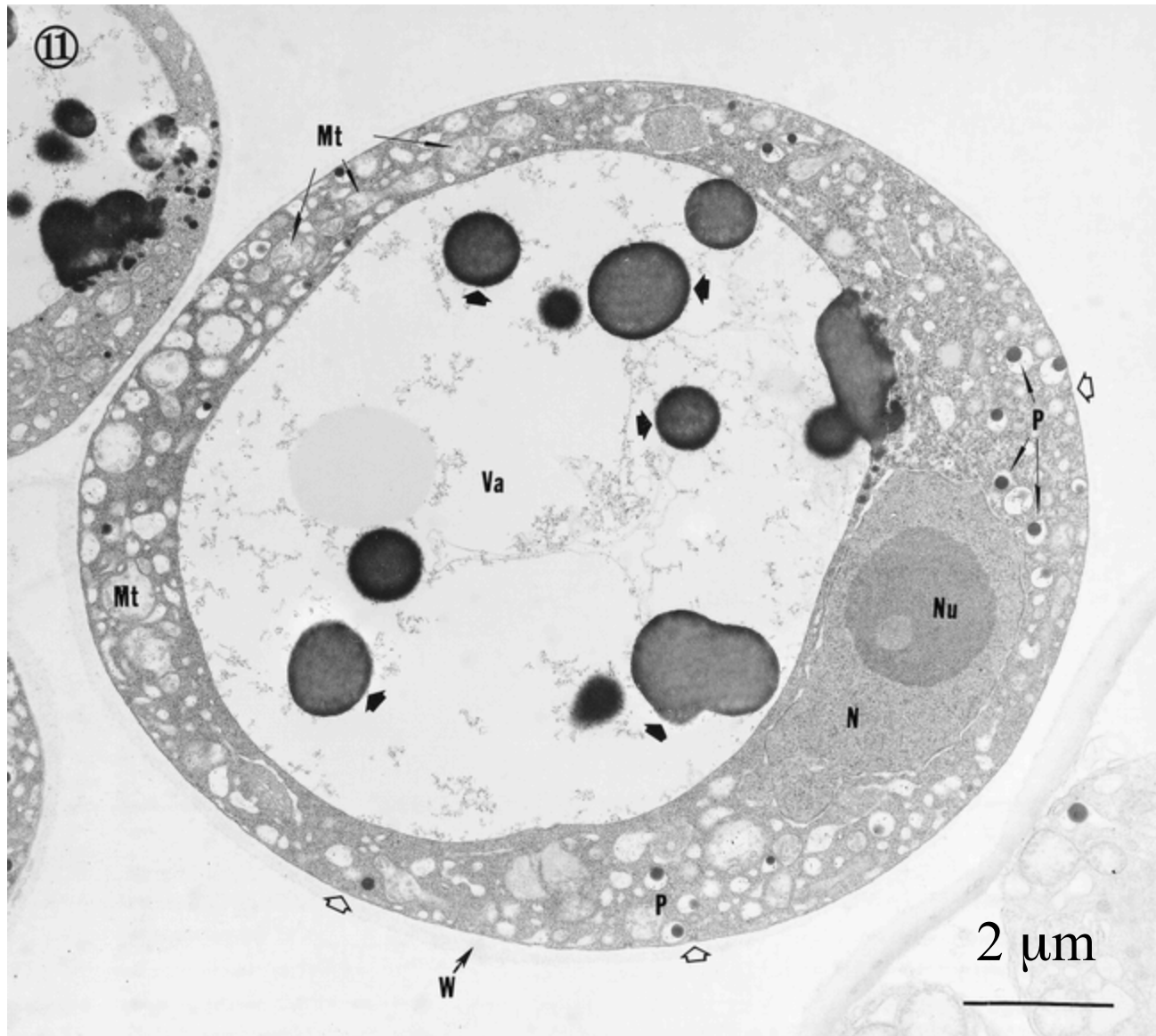
This micrograph shows a dense population of *Plasmodium marinus* parasites. The trophozoites are characterized by their large, rounded, uninucleate aplanospore-like appearance, often with a distinct signet ring stage. The schizonts or daughter cells are smaller and more numerous, appearing as dark, rounded structures. The background consists of host tissue, likely muscle, with visible striations and nuclei. A scale bar in the bottom right corner indicates 10 micrometers.

*P. marinus* schizonts or daughter cells

10  $\mu$ m



# *Perkinsus* mature trophozoite

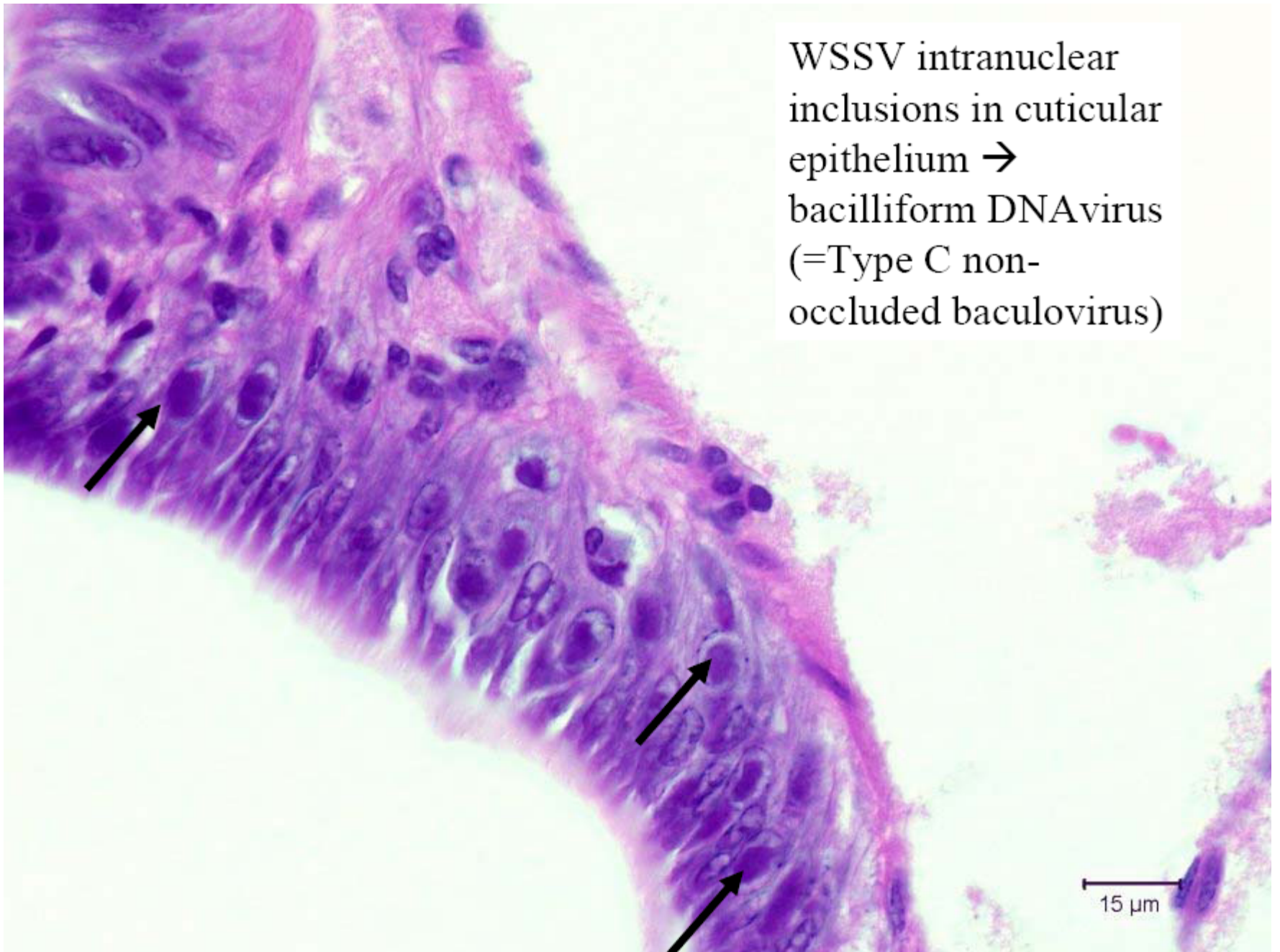


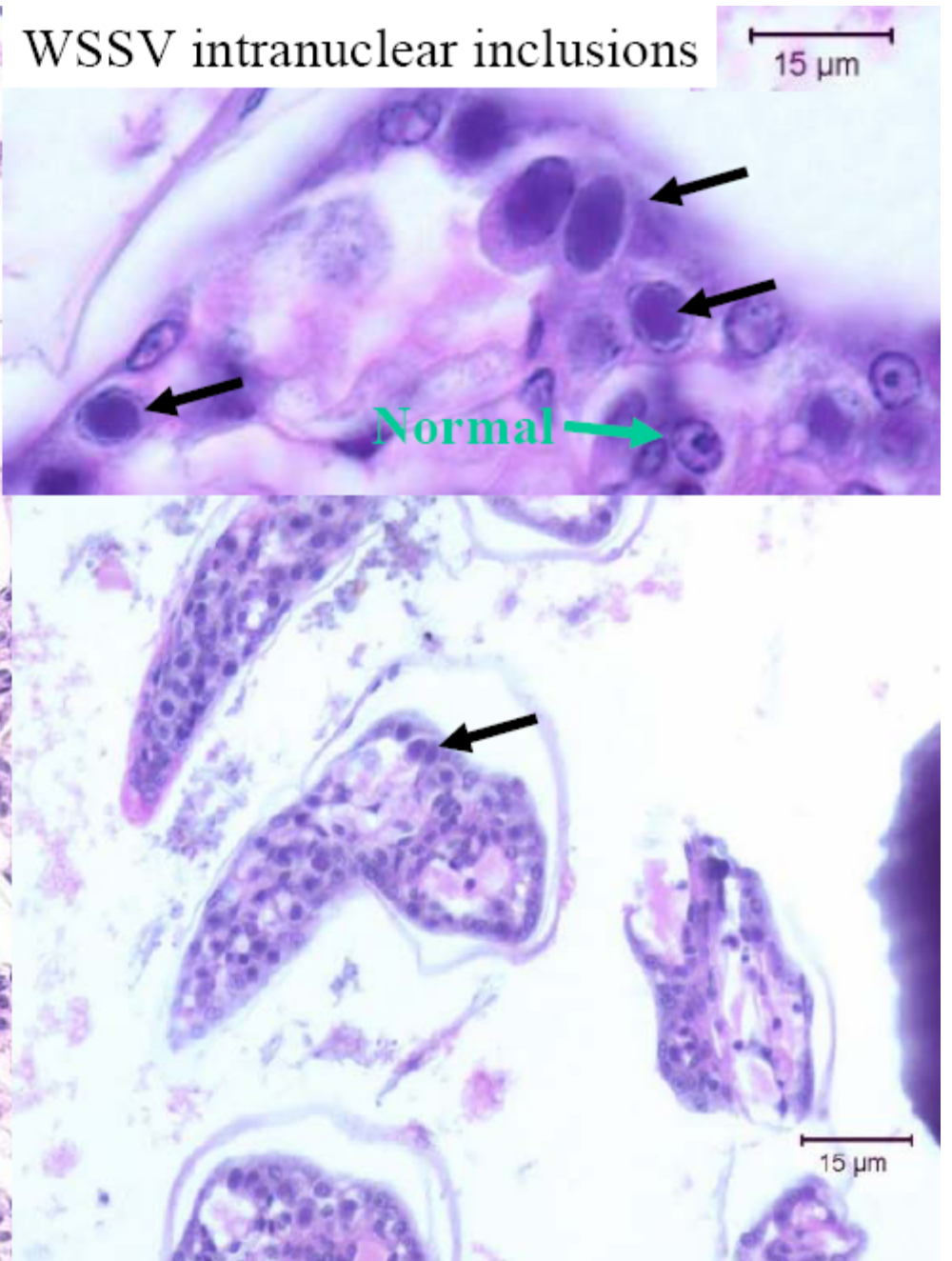
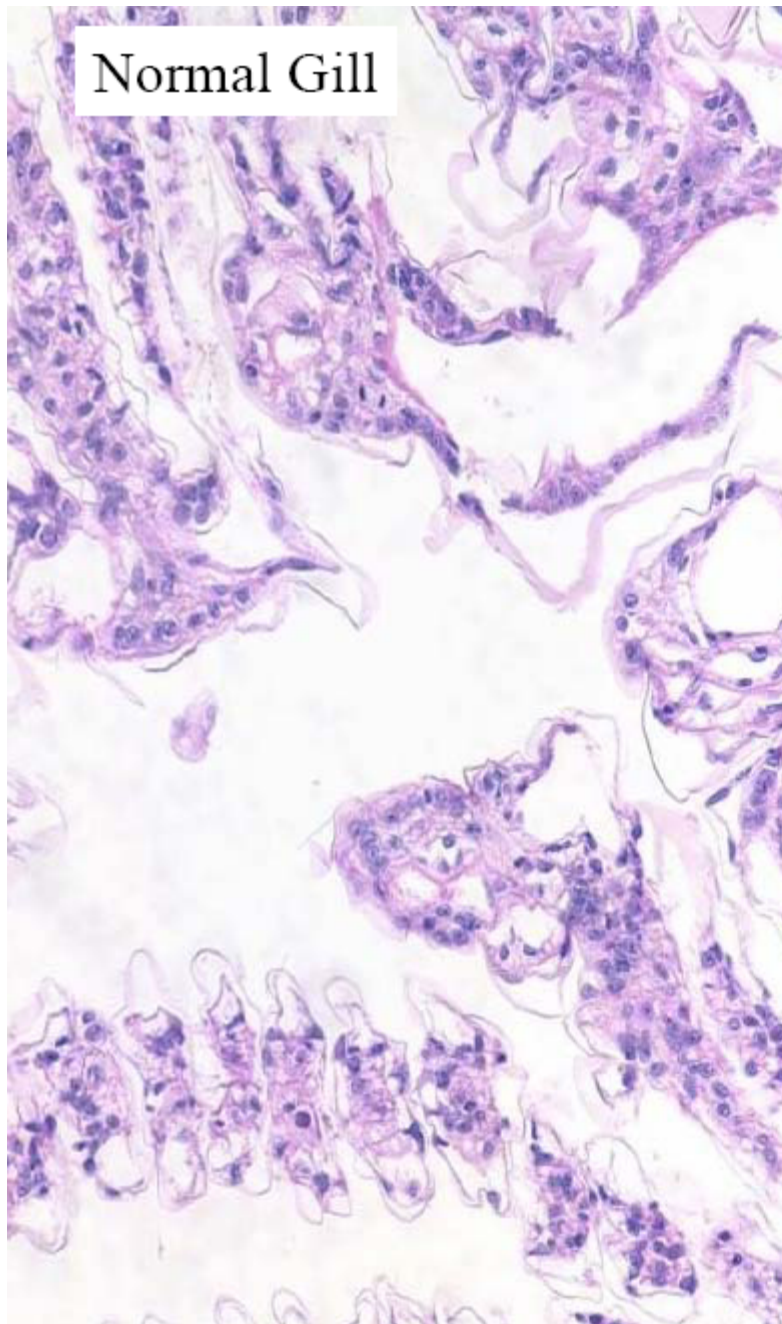
# White Spot Syndrome

- Highly lethal & contagious viral infection of crustaceans esp. penaeid shrimp; can wipe out an entire population in a few days
- **Causative agent:** White Spot Syndrome **Virus** (WSSV)
- **Clinical signs:** sudden reduction in food consumption, lethargy, loose cuticle and often reddish discoloration, and the presence of white spots of 0.5 to 2.0 mm in diameter on the inside surface of the carapace, appendages and cuticle over the abdominal segments.
- **Transmission:** mainly oral - water borne routes (horizontal transmission) and passed onto offspring (vertical transmission)
- **Histopathological changes:**
  - prominent **intranuclear** inclusions
  - cellular degeneration with hypertrophied nuclei and chromatin margination



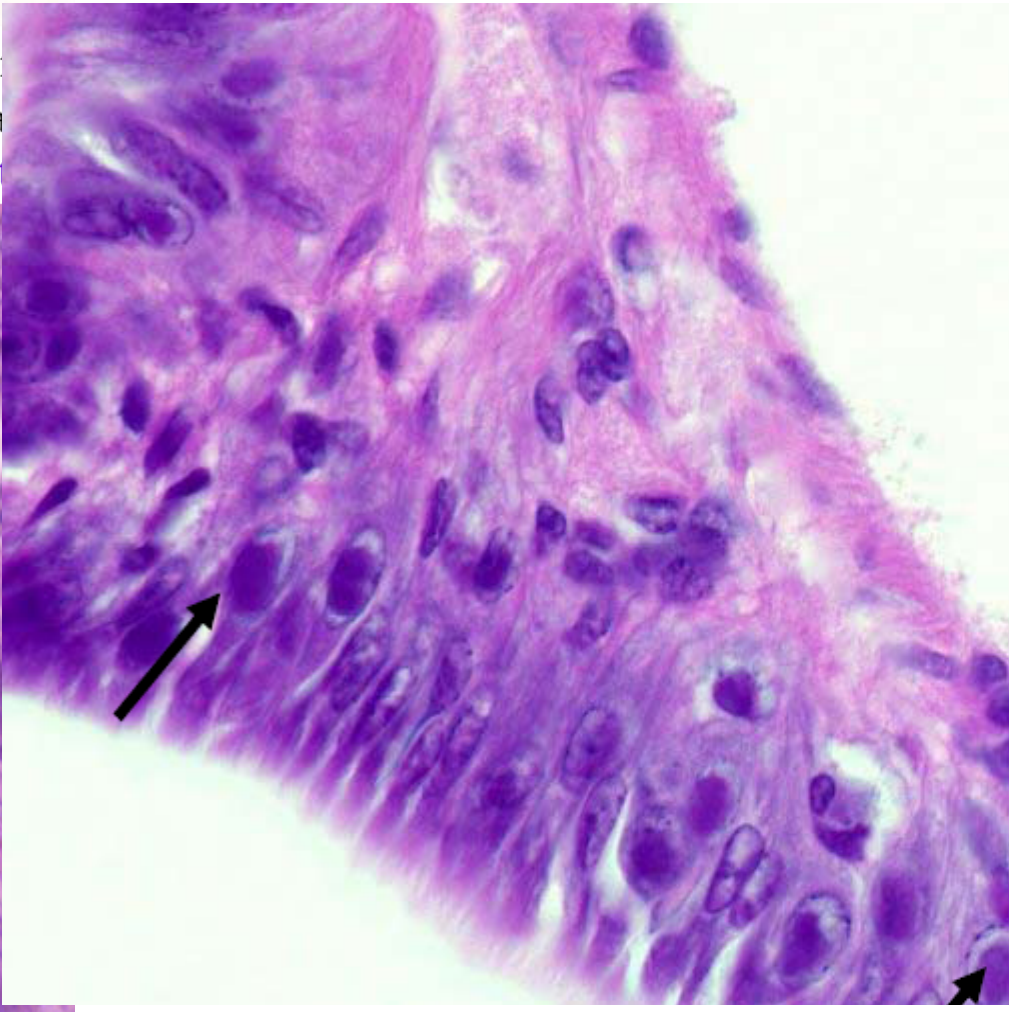
WSSV intranuclear  
inclusions in cuticular  
epithelium →  
bacilliform DNA virus  
(=Type C non-  
occluded baculovirus)





# DERMO vs Whitespot

## Can you tell the difference?



How else can you detect  
pathogens?