

**ENDOSYMBIOTIC, COMMENSAL, AND PARASITIC
ORGANISMS ASSOCIATED WITH WILD GEODUCK
CLAMS (*Panopea abrupta*)**

Carolyn S. Friedman, Brent Vadopalas

School of Aquatic & Fishery Sciences,
University of Washington
Seattle, WA USA

Paul Frelier

Mariscos Veterinary Services
Three Forks, MT **USA**

Ralph Elston

AquaTechnics
Sequim, WA USA

Introduction

- Farmed marine invertebrates are often non-native species
 - Criticism often focuses on the impacts of non-native and potentially invasive species on local species/ecosystems
 - Target and non-target species
 - Including pathogens
- Farming of native species may reduce potential concerns related to exotic species
- However, culturing native species within their natural range ensures that farmed and wild organisms can
 - Interbreed
 - Compete for the same resources
 - Share parasites and diseases

Introduction 2

- Cultured and wild animals may have disease impacts on one another
- Parasites or disease agents are naturally present in wild populations
 - Prevalence and intensity varies with species, locale, density, environmental conditions.....
- Disease organisms can achieve epidemic status in dense populations
 - High density plantings may facilitate disease transmission both within cultured and between wild and cultured populations
- Successful management or control of a disease agent is facilitated by an understanding of the presence and prevalence of potential pathogens in a population

We need to collect baseline data on the presence, identity and impact of parasites and diseases commonly encountered in the environment/species in question

Geoducks

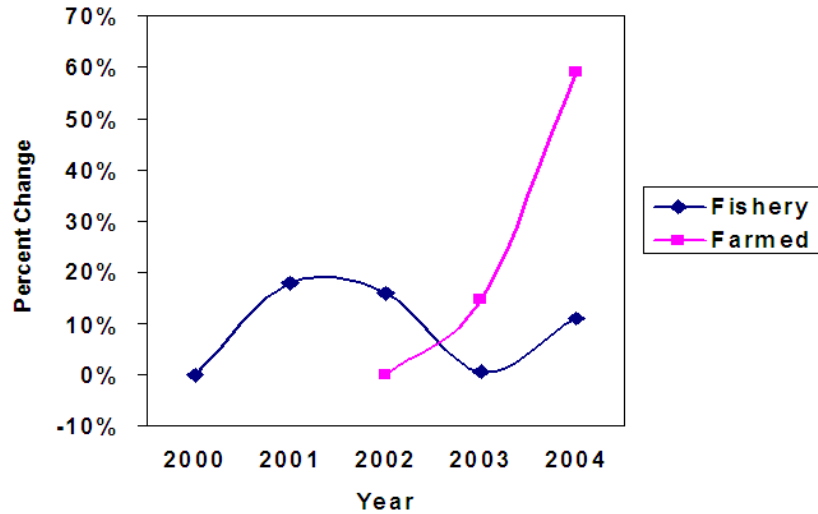
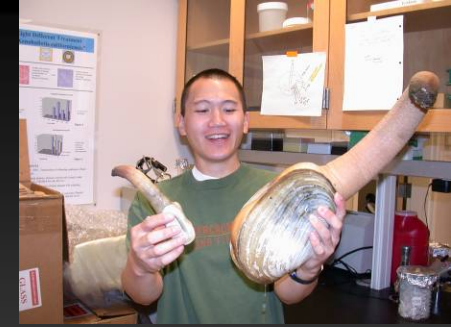


Fig. 1. Percent change in WA geoduck landings vs aquaculture production (Jonathan King, Northern Economics, Anchorage AK, personal communication).

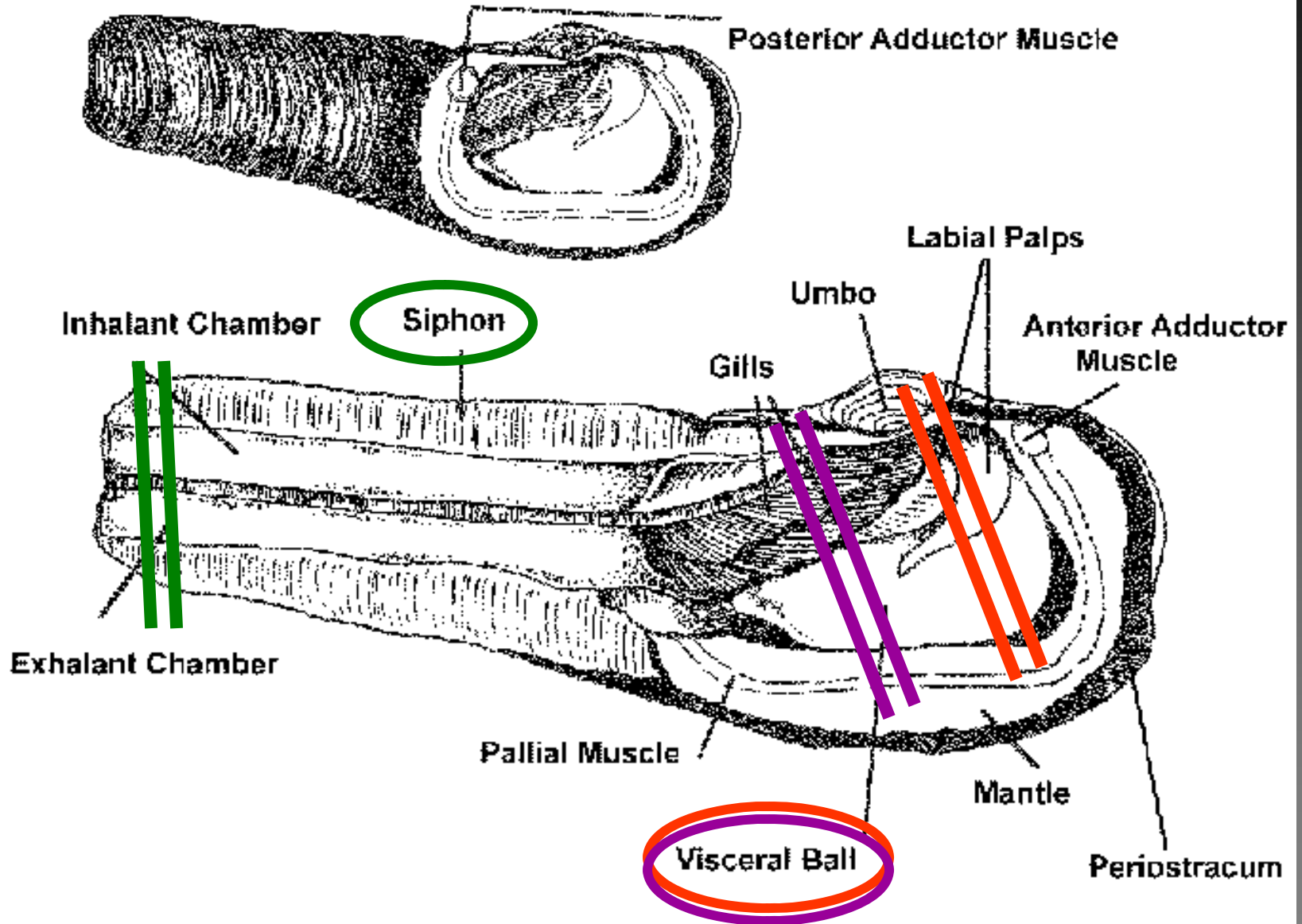


Methods

- Collected wild geoduck clams from three sites in the greater Puget Sound two times during two years
 - May and late September-early October 2007
 - August 2008 and January 2009
 - Freshwater Bay, Thorndyke Bay and Totten Inlet in Washington state



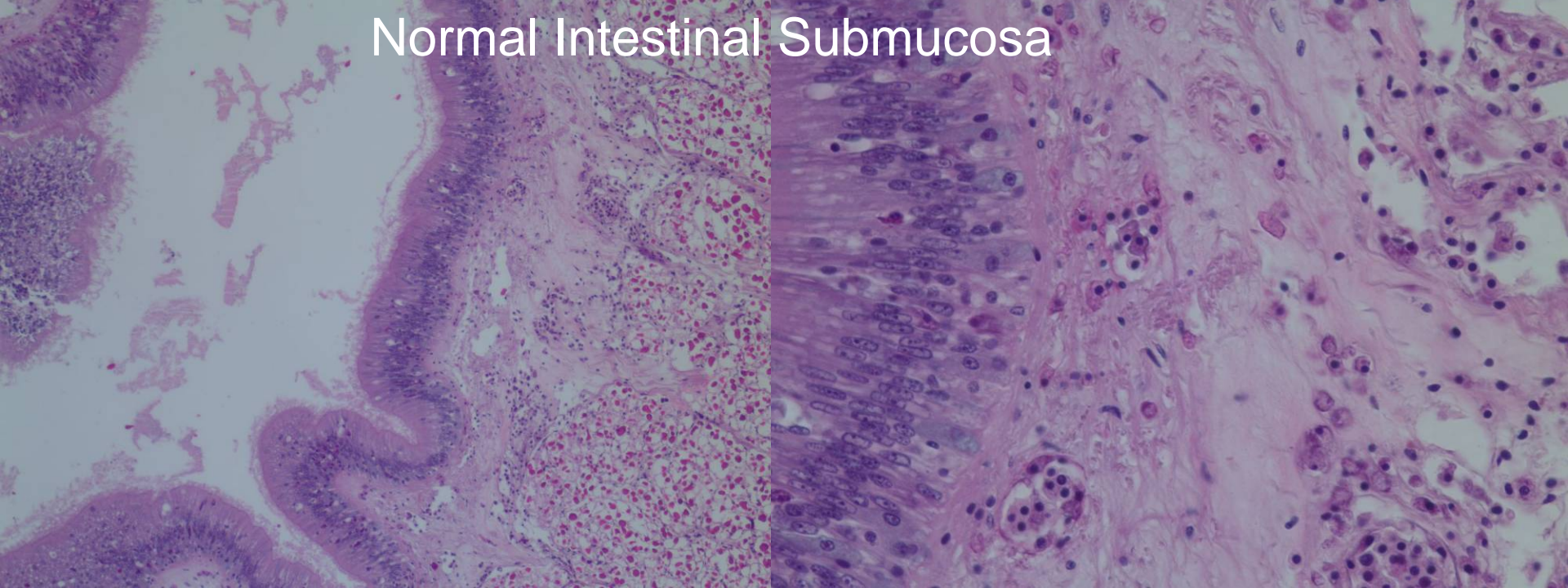
Processing samples: Geoduck Anatomy



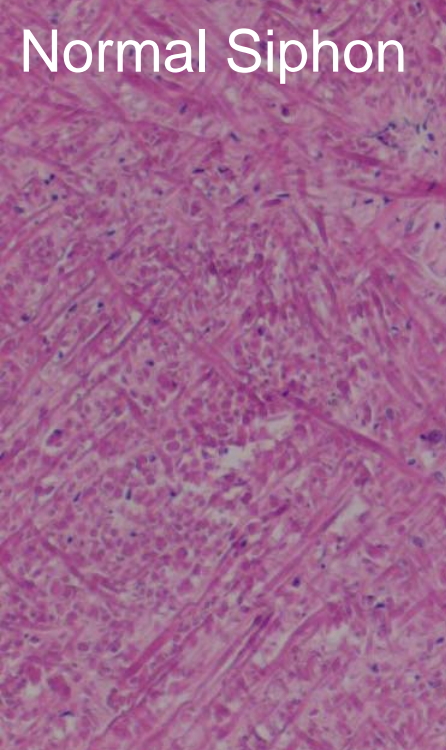
Summary of Geoduck Health from Totten Inlet

- **Sexes: 58% Male, 40% female, 2% unknown**
- **Parasites:**
 - **Microsporidia-like**
 - **Siphon: 7.5%**
 - ***Steinhausia*-like in ova 9.8%**
 - **Intestinal submucosa parasites 30%**
 - **Gill RLO 6.8%**
 - **Fungi 1.5%**
- **Diseases:**
 - **Siphon hyperkeratosis 17.3%**
 - **Digestive tubule inflammation 5.3%**
 - **Clogged gill water tubules 2.2%**
 - **Occasional warts**
 - **Siphon discoloration**

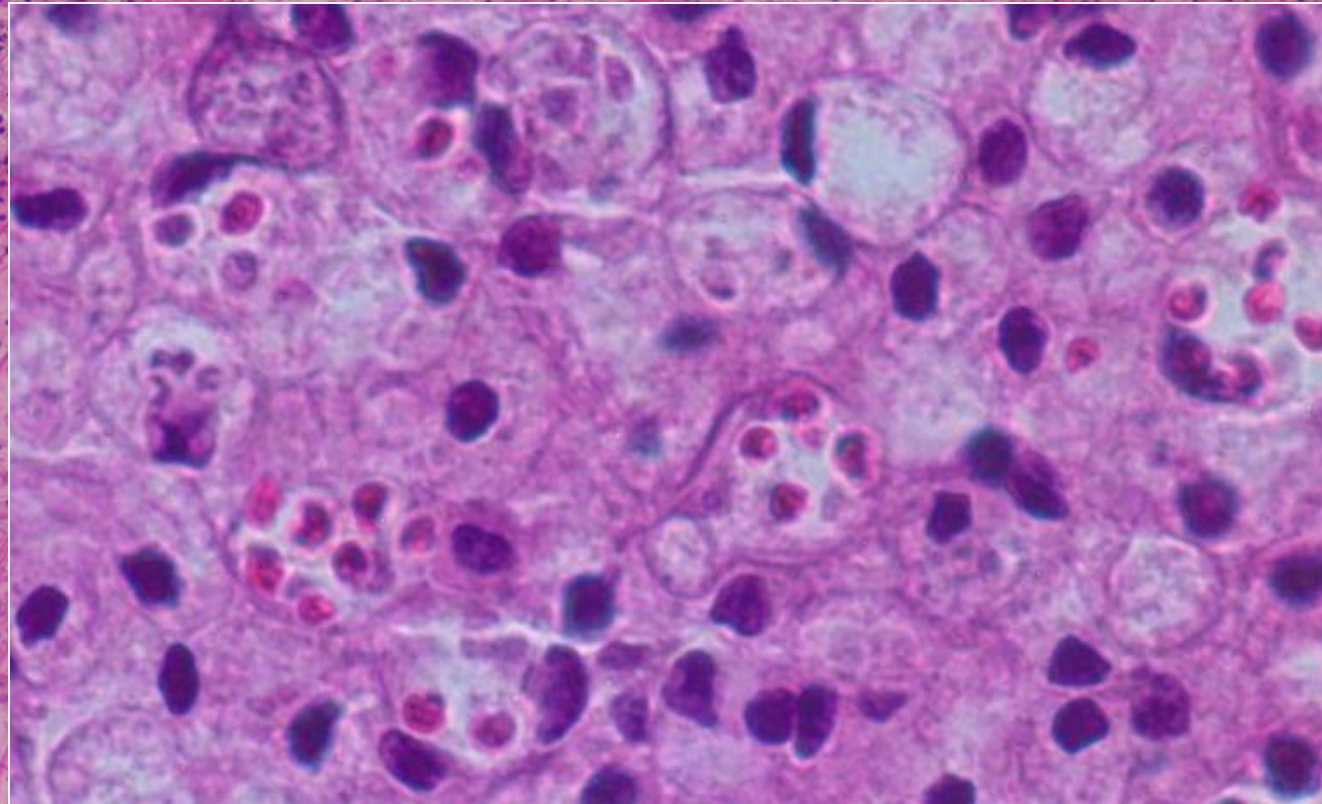
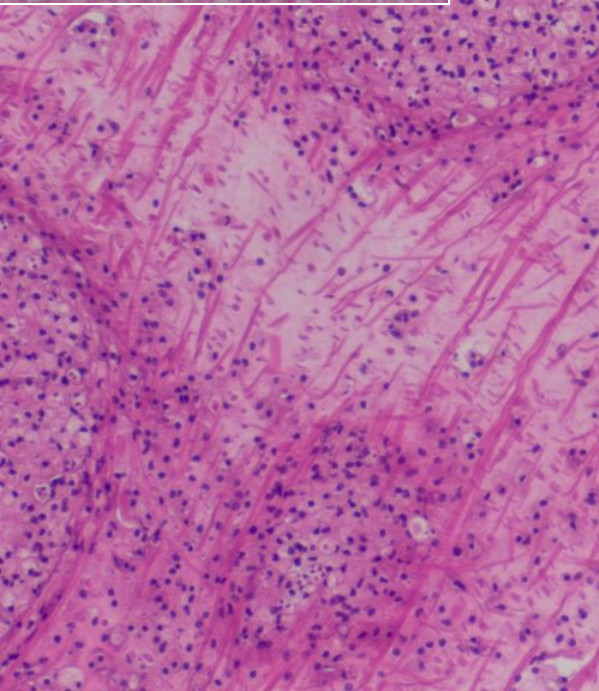
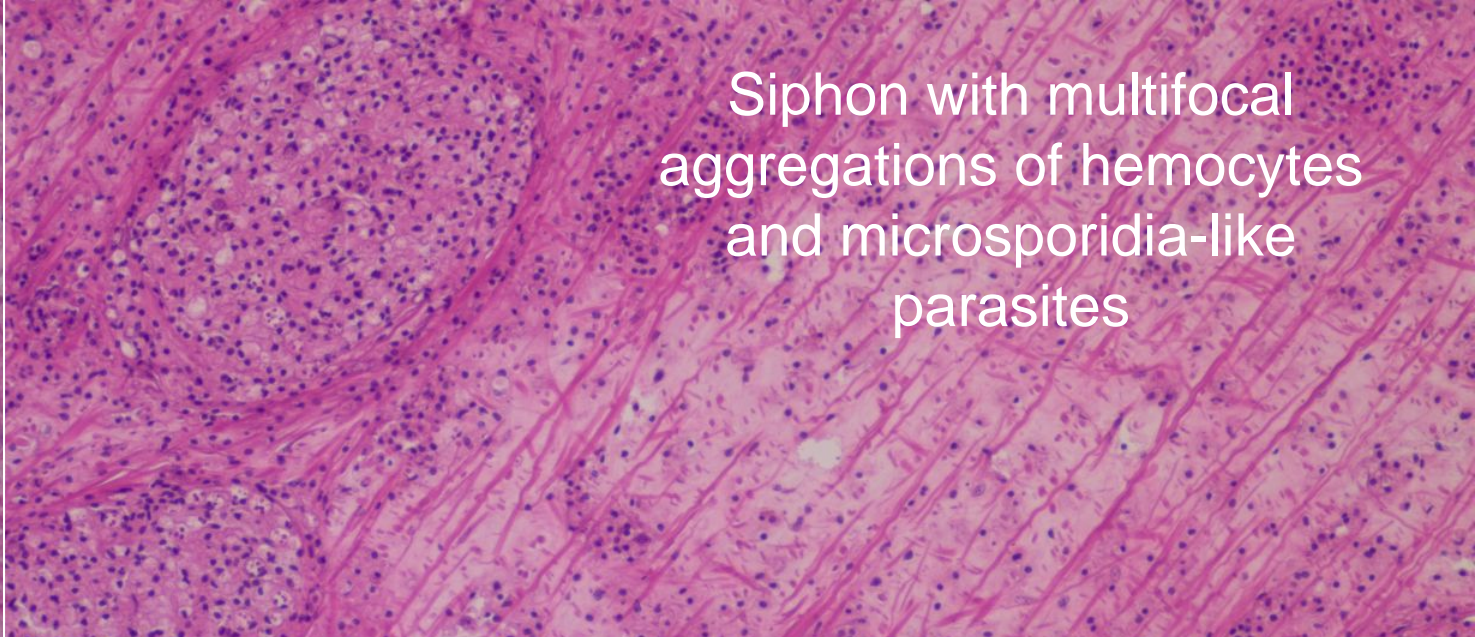
Normal Intestinal Submucosa



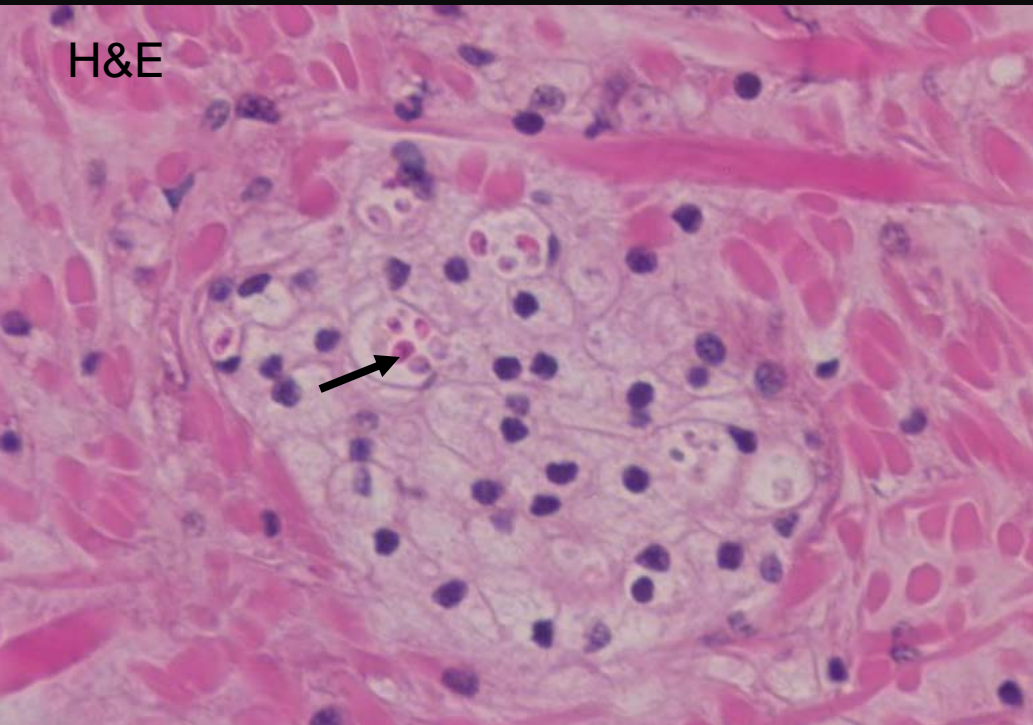
Normal Siphon



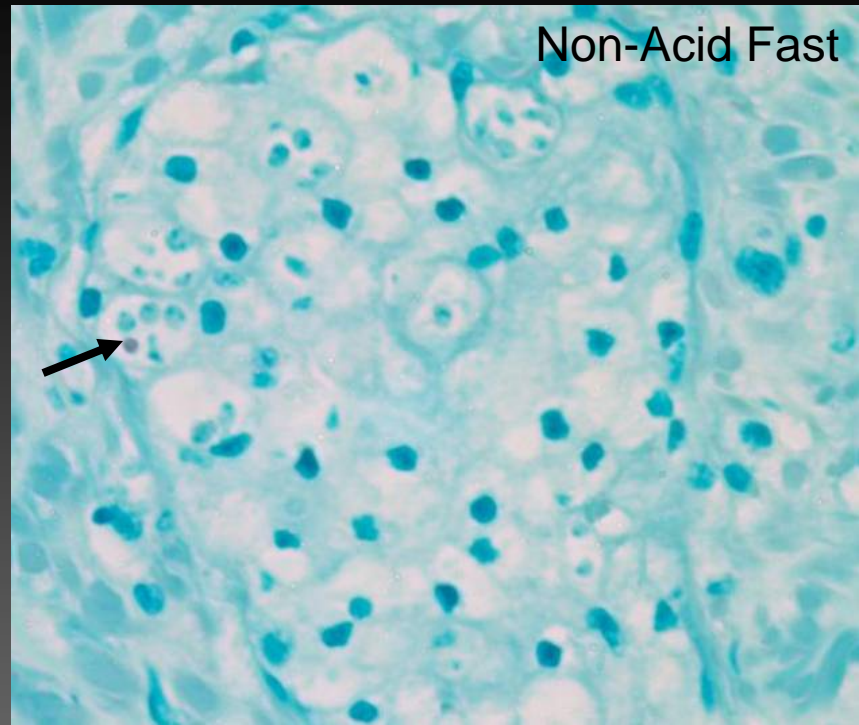
Siphon with multifocal aggregations of hemocytes and microsporidia-like parasites



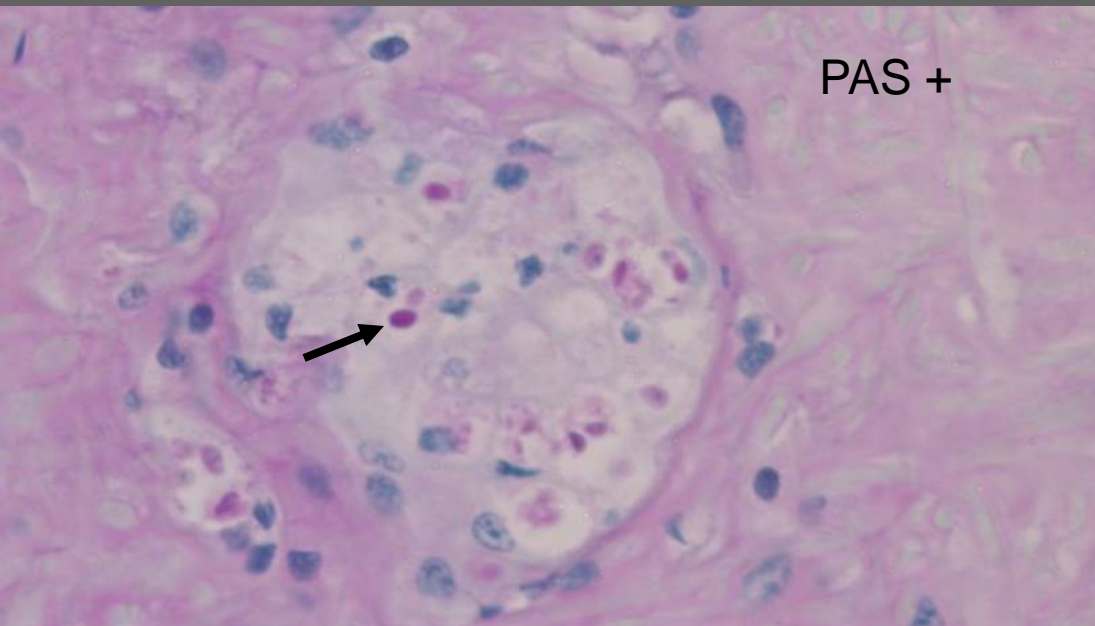
H&E



Non-Acid Fast

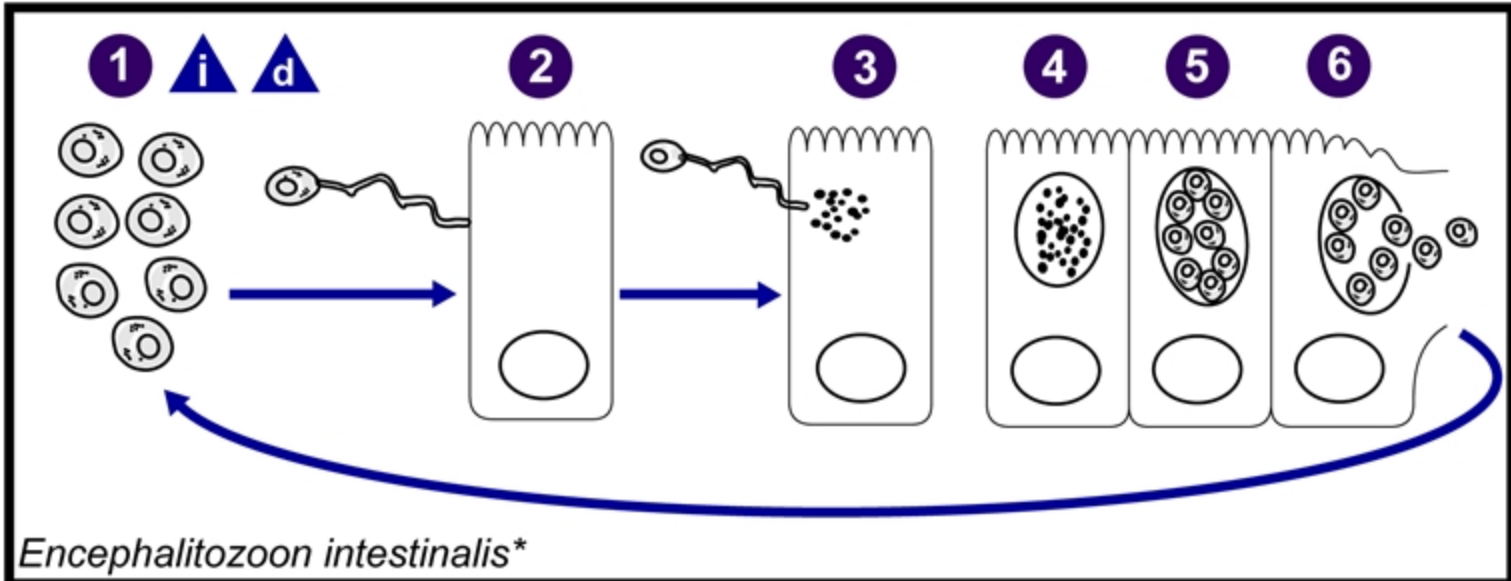
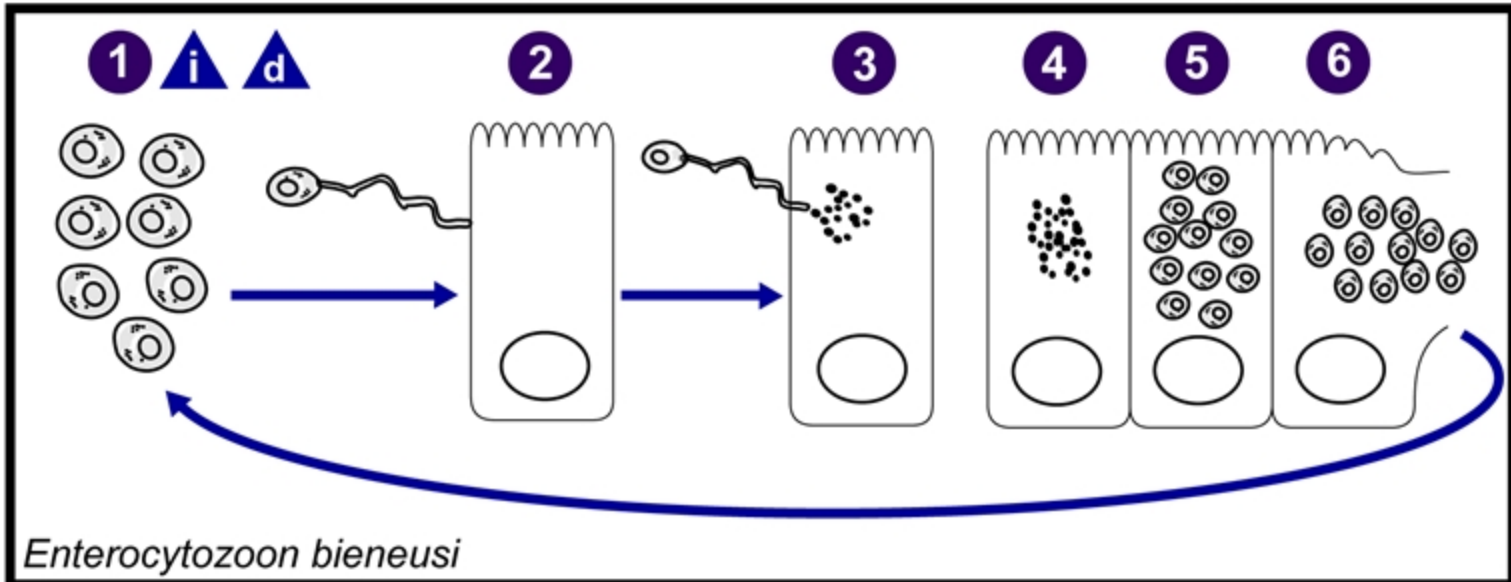


PAS +

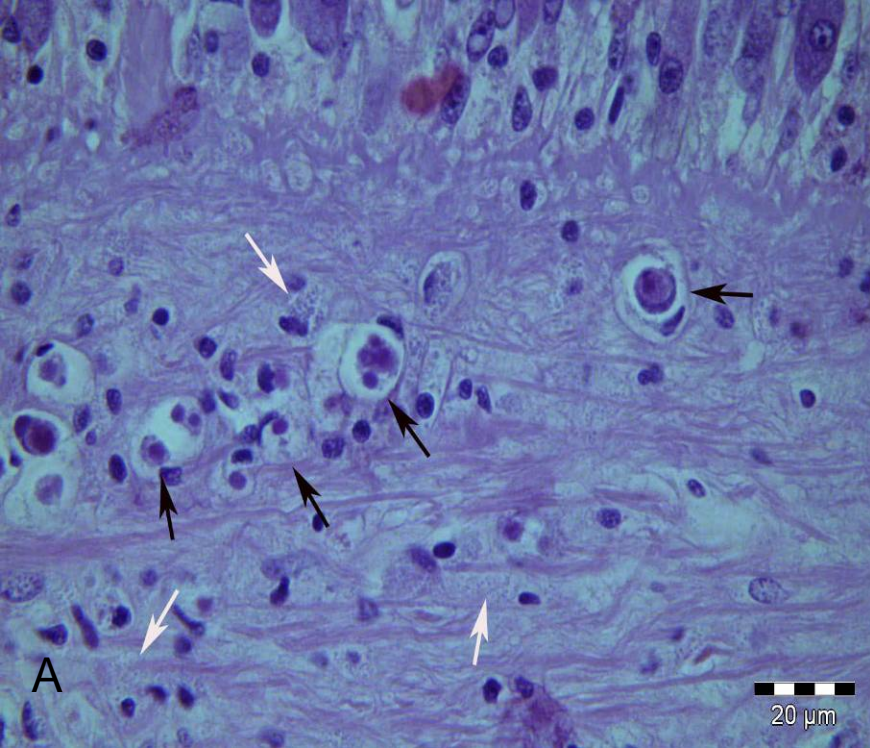


Parasite in siphon:
possible
microsporidian but
non-acid fast so
identity based on
morphology alone is
unclear

Intracellular development of *E. bienersi* and *E. intestinalis* spores.



*Development inside parasitophorous vacuole also occurs in *E. hellem* and *E. cuniculi*.



Parasites within GI
submucosa and siphon
musculature.

A. Plasmodia?

B. Spores?

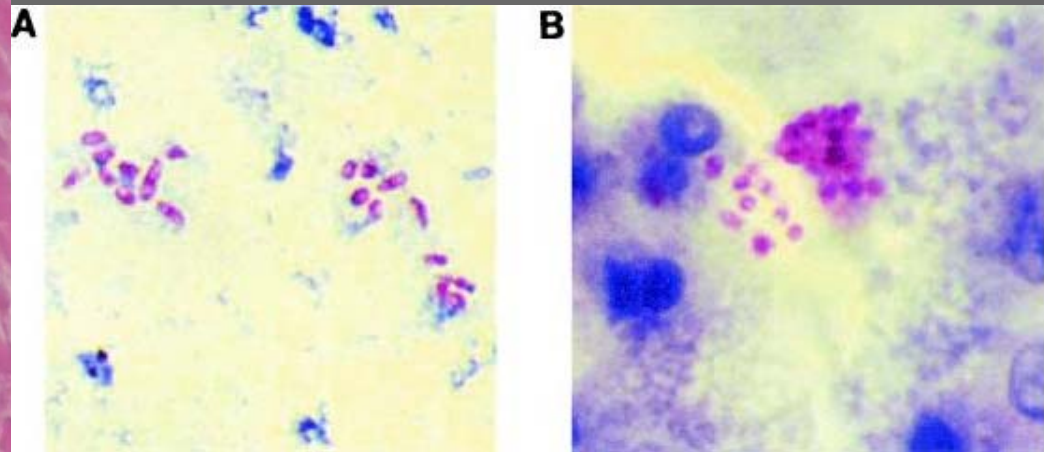
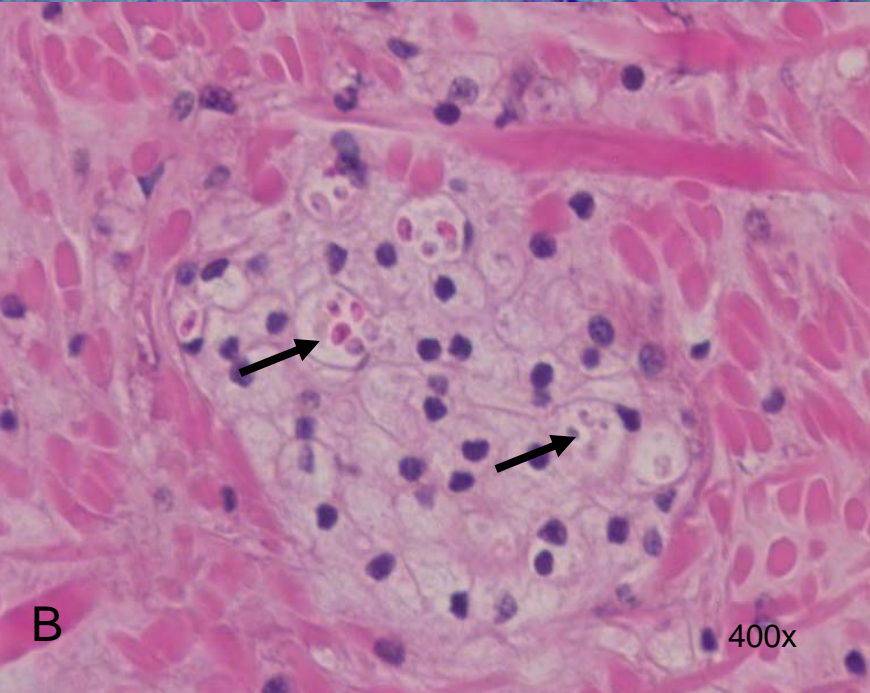
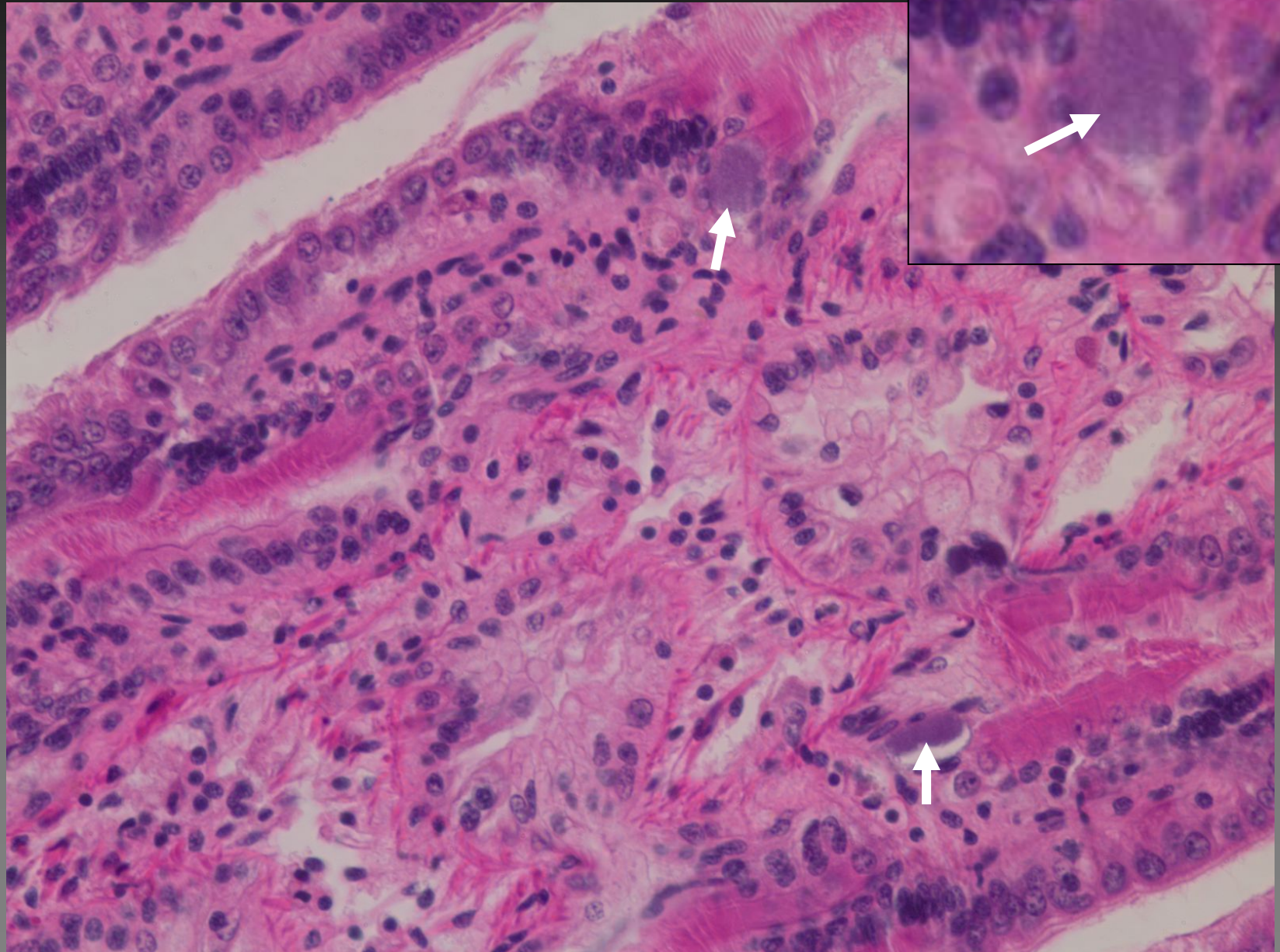
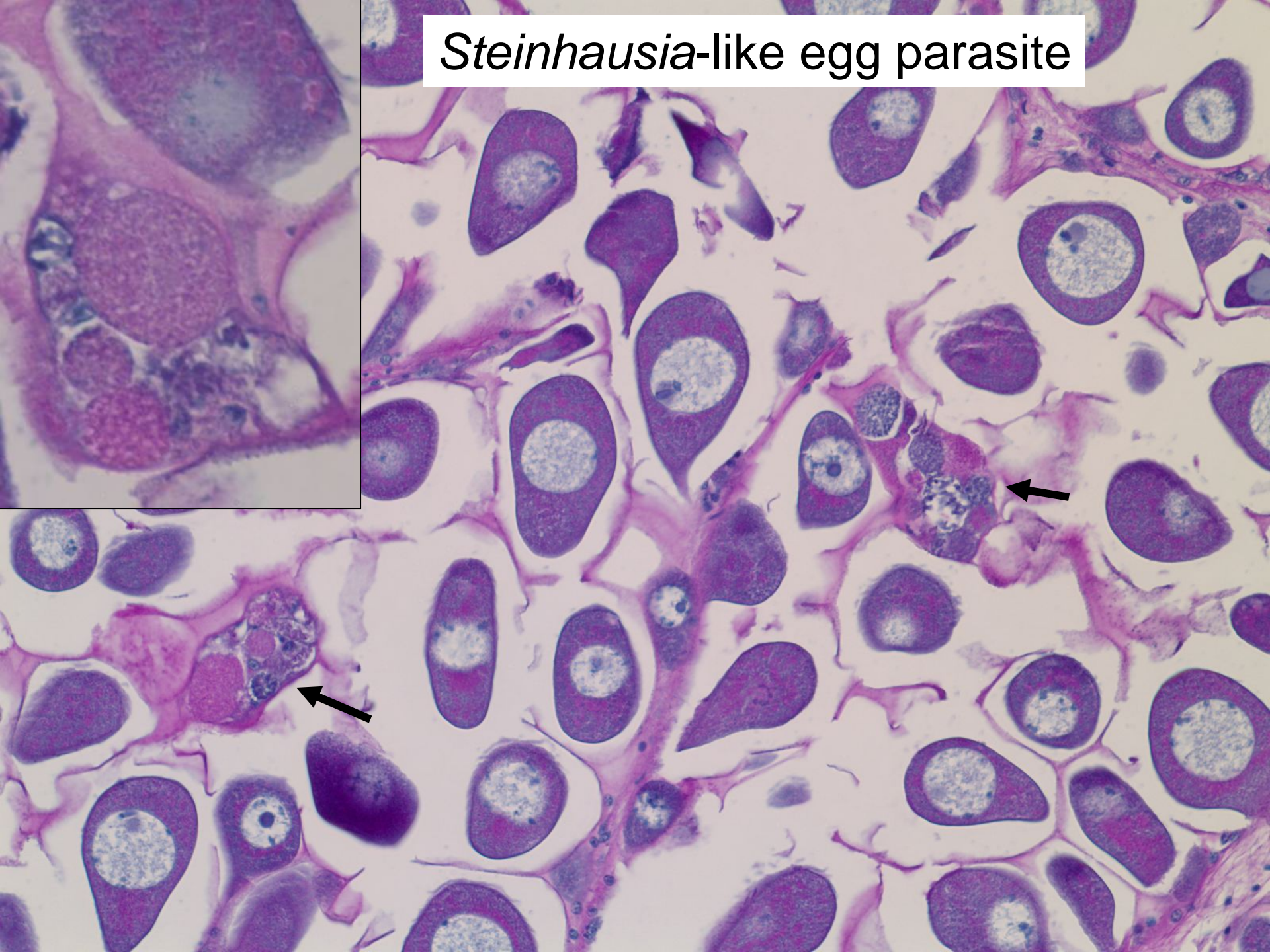


Fig 3. Garcia, LS. 2002. J Clin Microbiol. 40(6): 1892–1901

Gill RLOs



Steinhausia-like egg parasite



Steinhausia mytilovum



Bower, S. 2009. Image provided by J. B. Jones, Department of Fisheries, Government of Western Australia, bjones@agirc.wa.gov.au

Steinhausia-like parasite

- Of slides examined to date:
- 30% Only seen in geoducks from Totten Inlet
- None from Thorndyke Bay
- None from Freshwater Bay
- Low intensity infections (scale = 1)
- Lacked a host response

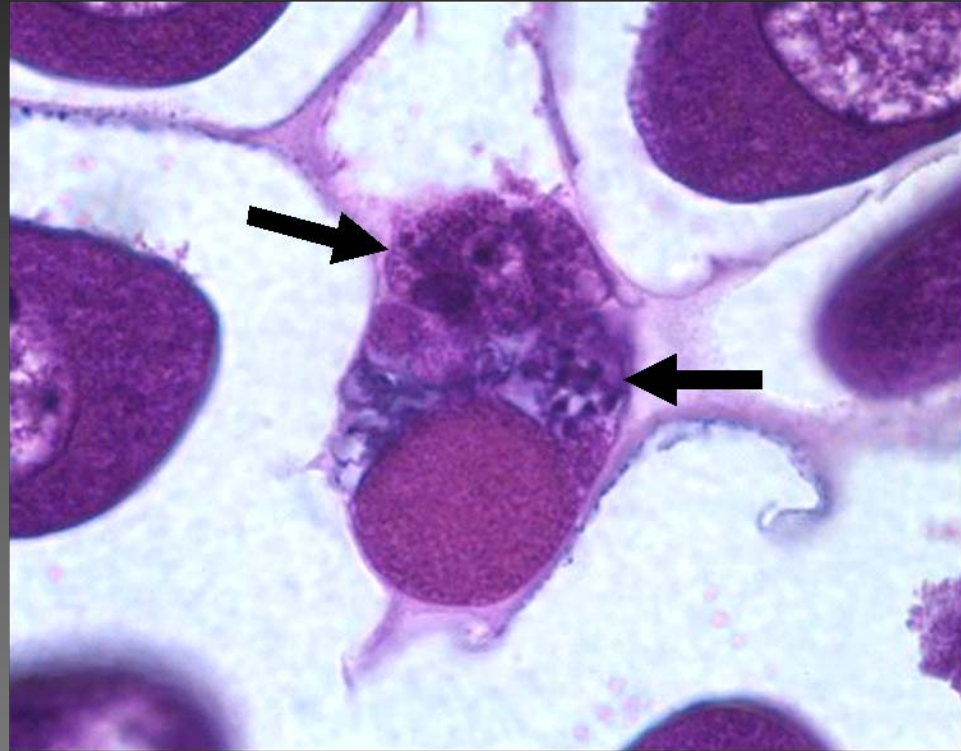
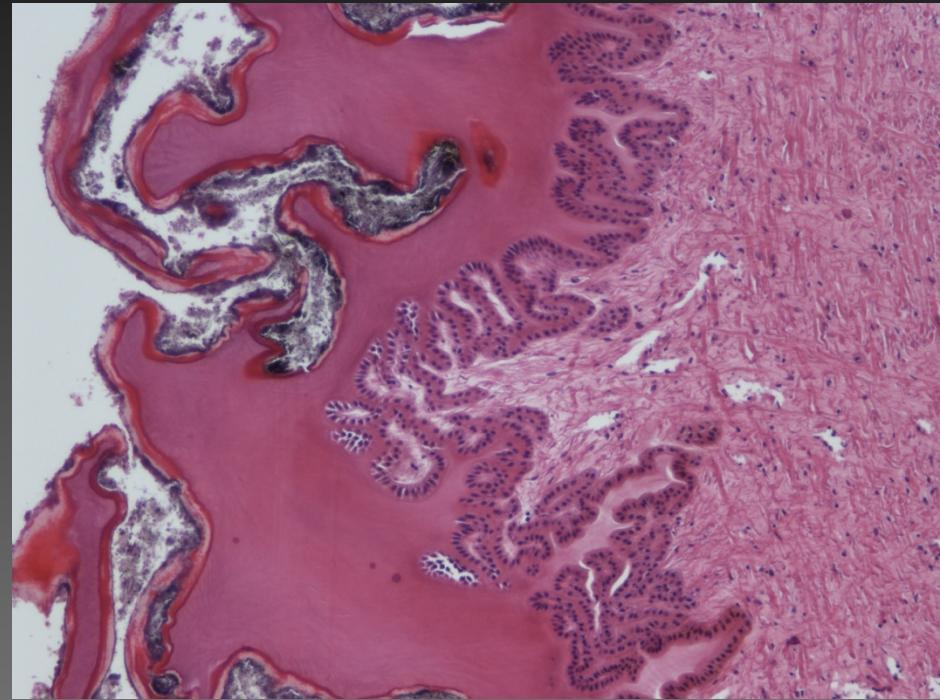
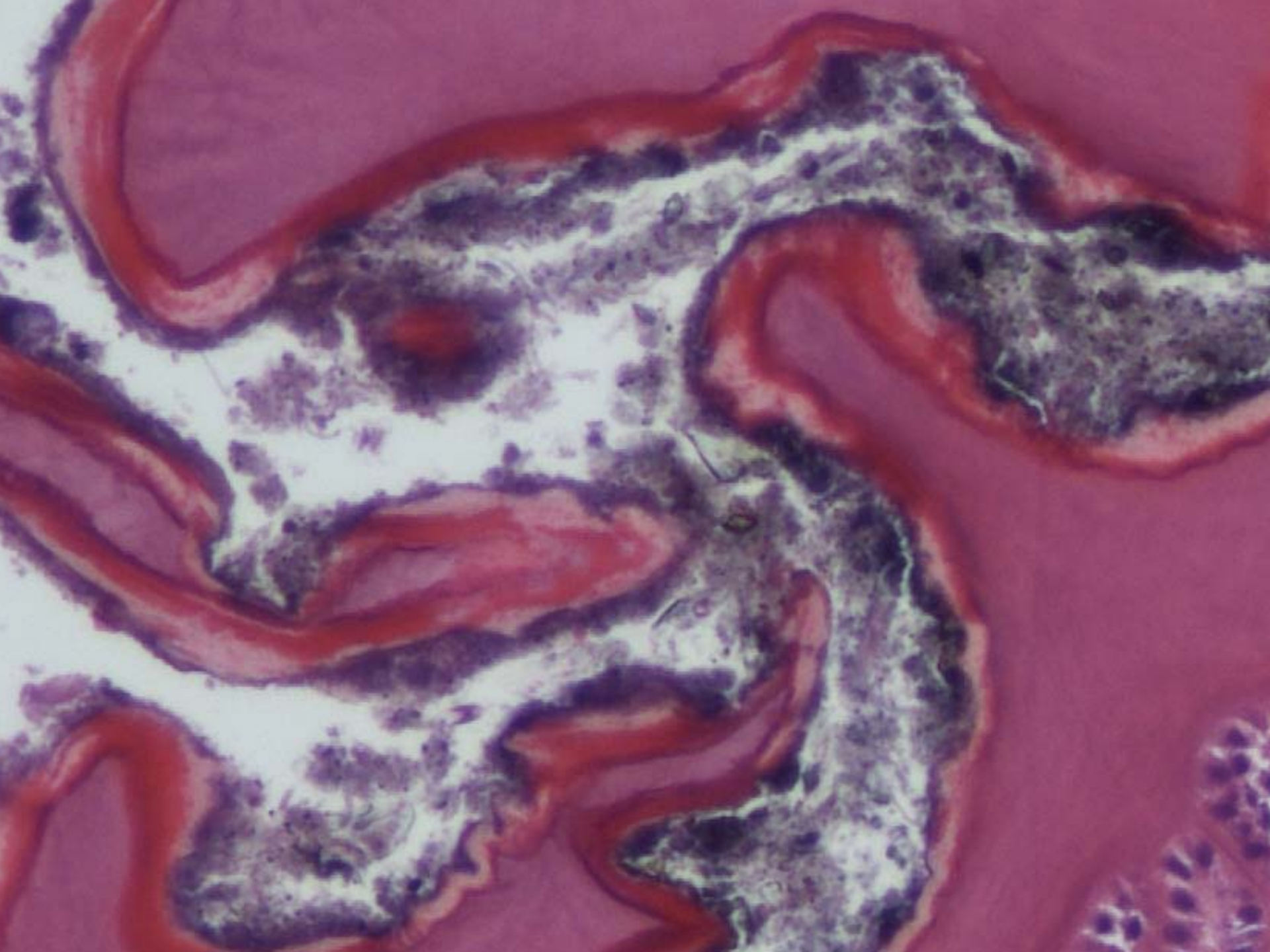


Figure 4. Microsporidian-like parasites within geoduck egg (arrows).

Mantle Abnormalities

- Hyperkeratosis and epithelial discoloration
- Warts on siphon epithelium seen periodically





Conclusions

- Baseline data is important to assess the health of our native and farmed populations
- We have detected 5 parasites in Puget Sound geoduck populations
- We need to develop tools to further our understanding of the host-parasite relationships of these parasites

Acknowledgements

- **WDFW – Bob Sizemore and Shellfish Dive Team**
- **WDNR – Celia Barton and DNR Divers**
- **Jamestown S’Klallam Tribe – Kelly Toy and colleagues**
- **Joth Davis – Taylor and Baywater Inc**
- **Adriana Santa Cruz -UW**
- **Frank Morado – NOAA**

Acknowledgements

- **National Sea Grant – National marine aquaculture initiative**
- **Washington Sea Grant – Washington state geoduck program**
- **School of Aquatic and Fishery Sciences, University of Washington**