**ALVEOLATES**

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**WHAT IS IT?**

- **Alveolates**: Major superphylum of protists  
- Group of single-celled eukaryotes that get their nutrition by predation, photoautotrophy, and intracellular parasitism  
- Spherical basophilic organisms (6-9 µm diameter)  
- Most notable shared characteristic is presence of cortical alveoli, flattened vesicles packed into linear layer supporting the membrane, typically forming a flexible pellicle

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**WHAT IS IT?**

- 3 main subgroups:  
  - Ciliates: predators that inhabit intestinal tracts and flesh  
  - Dinoflagellates: mostly free living predators or photoautotrophs, release toxins  
  - Apicomplexans: obligate parasite; invade host cells  
- Several other lineages such as:  
  - Colpodella  
  - Chromera  
  - Colponema  
  - Ellobiopsida  
  - Oxyrrhis  
  - Rastrimonas  
  - Parvilucifera  
  - Perkinsus

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(Leander, 2008)
HOW DOES IT KILL AMPHIBIANS?

- Cause infection and disease in amphibian populations
  - Infection = parasite occurs in host; occupying intestinal lumen
  - Disease = advanced infection; presence of spores in tissues; occupying intestinal, liver, skin, rectum, adipose tissue, pancreas, spleen, kidney, and somatic musculature
- Effects on organs
  - Filters into host's internal organs in mass amounts
  - Causes organ enlargement and severe tissue alteration
  - Obliterates kidney and liver structure
- System shut-down = DEATH

How its introduced to environment:
- Birds
- Insects

How it spreads/transmission:
- Ingestion of spores
- Feces of infected individuals
- Tissues from dead/dying infected tadpoles
- Free-floating spores

HOW DOES IT KILL AMPHIBIANS?

Environmental influence
- pH of water (5.5-7.5 = mass zoospore hatching)
- Salt = mass zoospore hatching
- Zoospores = disease condition = DEATH

Variety of host species

Age of amphibian
- Kills off tadpoles
- Sometimes persists through metamorphosis

Infection in adults
- Very high rates of mortality

EVIDENCE OF DIE-OFFS OR DECLINES?

- (Green, 2002):
  - Severe infection to be the cause of 2 mortality events and contributor to 2 other mortality events occurring only in Ranid tadpoles in MN, MI, NC, and NH
  - Occurred in no onset pattern & each of the 4 events occurred in 4 separate months
  - Observations suggesting that infection causes >95% mortality rate in this population of tadpoles
  - Parasite said to be undetermined, but resembles Dermocystidium
- (Jones et al. 2012):
  - Analysis of rRNA sequence reveal that the organism from Green's experiment is actually most closely related to type of alveolate protozoa

(Cook, 2008)
Multispecies amphibian larval mortality event
- American bullfrogs (L. catesbeianus)
- Southern leopard frogs (L. sphenocephalus)
- Gopher frogs (L. capito)

Occurred in Florida
- Only major events due to alveolate parasite

Die-off in pond
- Infection increased since survey
- No older bullfrogs 2 months later

Mortality event of southern leopard frog (R. sphenocephala)
- Northeast Georgia
- Surveyed 5 ponds
- 25% of 87 specimens were infected
- Complete, rapid die-off of R. sphenocephala tadpoles in one pond while surveys were still going on
- All organs infected
  - Mostly liver and kidneys
  - Swelling of organs

Mass mortality of gopher frog (R. servosa) tadpoles
- Infection by Dermomyxocetes sp.
- Primary breeding pond in Mississippi
- Zoospore penetration
- Death within weeks post-embryo
- Lab infections
- Infected species of Rana, Acris, Hyla, Pseudacris, and Gastrophryne
- Disease condition in R. gratiosa, R. capito, R. catesbeiana, R. clamitans, R. servosa, and R. sphenocephala

Documented places of infection and disease:
- Florida, Georgia, Mississippi, Maine, New Hampshire, Virginia, North Carolina and Minnesota

Documented species infected and deceased from infection:
- R. servosa, R. sphenocephala, R. sylvatica, R. clamitans, R. catesbeiana and R. crucifer
New and emerging parasite
- All species are potential hosts, not just specific species as seen in Ranavirus
- No limit on occurrence to a certain time period or place
  - Reported in variety of geological areas & in different seasons
- No pattern of environmental requirements
  - Overwhelms populations with little to no recovery after infection occurs
  - No way to combat it
- Completely destroys the organs causing failure
- Alveolate infections are moving/spreading geographically
  - First reported event in New Hampshire and now has reached Alaska, Georgia, Florida, Maine, Minnesota, Missouri, North Carolina, and Virginia
- Large realm of unknown
  - Halts prevention

Why Is It the Most Important?

- Cook JO (2008) Transmission and occurrence of Dermomy-coides sp. in Rana sevosa and other ranids in the North Central Gulf of Mexico States. MS thesis, University of Southern Mississippi, Hattiesburg, MS.