

Variable Life History Traits in *Monocystis* sp.

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Monocystis

- ▶ Phylum: Apicomplexa
- ▶ Class: Gregarinomorpha (“classical gregarines”)
- ▶ Studied since ~1900
- ▶ Considered an exemplar parasite of the gregarines



Monocystis sp. in *Amyntas agrestis*

- ▶ *A. agrestis* colloquially known as the “crazy snake worm”
- ▶ earthworm has annual life cycle (early April - early November)
- ▶ putatively transmitted horizontally



Life History Questions and hypotheses

- ▶ What is the phenology of the parasite and does the phenology differ between two sites?
 - ▶ H0: The phenology of the parasite at HF and AU is not different
 - ▶ HA: The phenology of the parasite at HF and AU is different
- ▶ What is the life history of the parasite (sporocysts/gametocyst) and does this vary between sites?
 - ▶ H0: There is no difference in sporocysts/gametocyst between sites
 - ▶ HA: There is a difference in sporocysts/gametocyst between sites

Study Sites

- ▶ Earthworms from each site collected every week from April 6, 2015 - November 10, 2015
 - ▶ University of Vermont Horticultural Research and Education Center (Hort Farm, or HF)
 - ▶ Centennial Woods Natural Area (CW)
 - ▶ Green Mountain Audubon Center (AU)

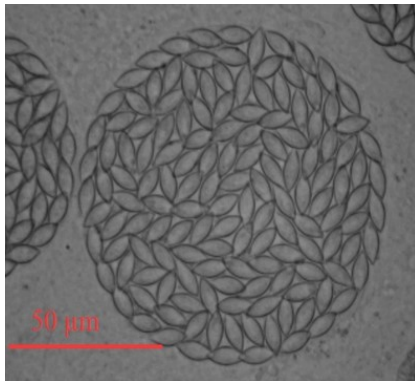


Methods - Phenology and Measuring Parasitemia

- ▶ 10 worms/site dissected each week
- ▶ infection status determined (infected, not infected)
- ▶ Counted # parasites/1uL homogenized seminal vesicle
- ▶ Total parasitemia = parasites/1uL x total volume seminal vesicle (uL)

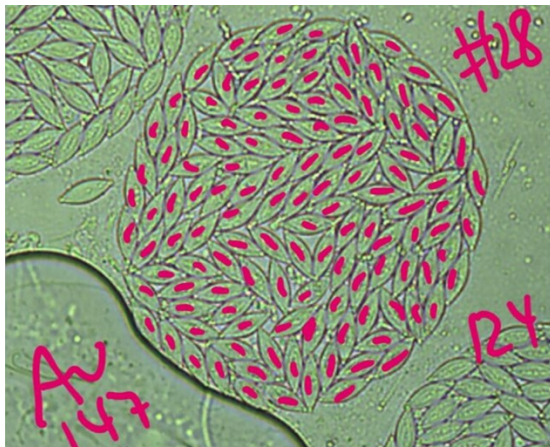
Methods - Selecting a Life History Trait

- ▶ Life history trait: sporocysts/gametocyst
- ▶ gametocyst formed from mating of two parasites
- ▶ gametocyst contains variable number of sporocysts
- ▶ 1 sporocyst gives rise to 8 parasites capable of establishing infection
- ▶ sporocysts/gametocyst can be used as estimate of reproductive output



Methods - Measuring Sporocysts/Gametocyst

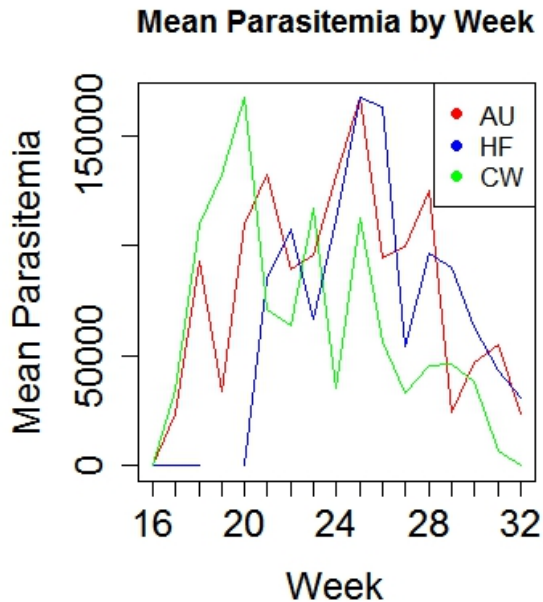
- ▶ 10 earthworm infections per site
- ▶ Images of 30 gametocysts/earthworm
- ▶ Determined # sporocysts/gametocyst
- ▶ Total = 600 gametocysts counted



Analysis - Life History Traits

- ▶ Conducted Shapiro-Wilk Normality Test on counts for HF and AU
- ▶ Nested ANOVA
 - ▶ Groups: Sites (HF and AU)
 - ▶ Subgroups: individuals

Parasite Phenology Results



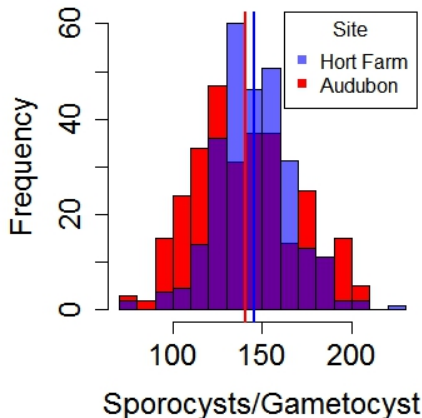
Parasite Phenology Results

- ▶ AU and CW same phenology (weeks 16-32)
- ▶ HF has shorter season (weeks 20-32)
- ▶ Week 33 was a hard-freeze at all sites and killed all worms

Sporocysts/Gametocyst Results

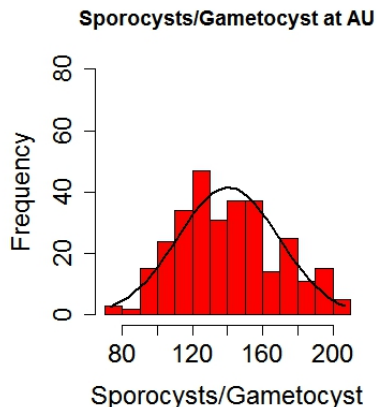
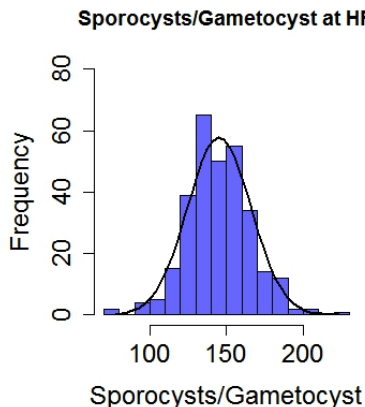
- ▶ Quite a bit of overlap of the histograms
 - ▶ Audubon: mean = 140.39, sd = 28.81
 - ▶ Hort Farm: mean = 145.21, sd = 20.71

Sporocysts/Gametocyst at HF and AU



Normality Results

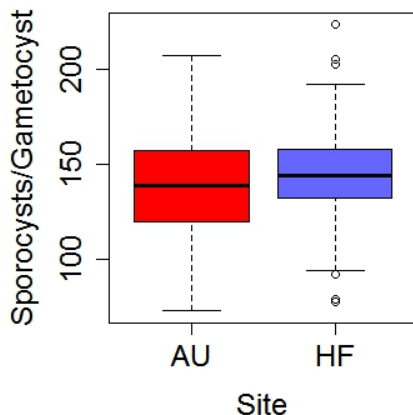
- ▶ Shapiro-Wilk Normality Test Results
 - ▶ Audubon: $W = 0.98394$, $p\text{-value} = 0.00194$
 - ▶ Hort Farm: $W = 0.99056$, $p\text{-value} = 0.05046$



Nested ANOVA

- ▶ Nested ANOVA Results
 - ▶ Site: $F = 9.08$, $p\text{-value} = 0.0027$
 - ▶ Individual: $F = 22.34$, $p\text{-value} = <2e-16$

Sporocysts Per Gametocyst



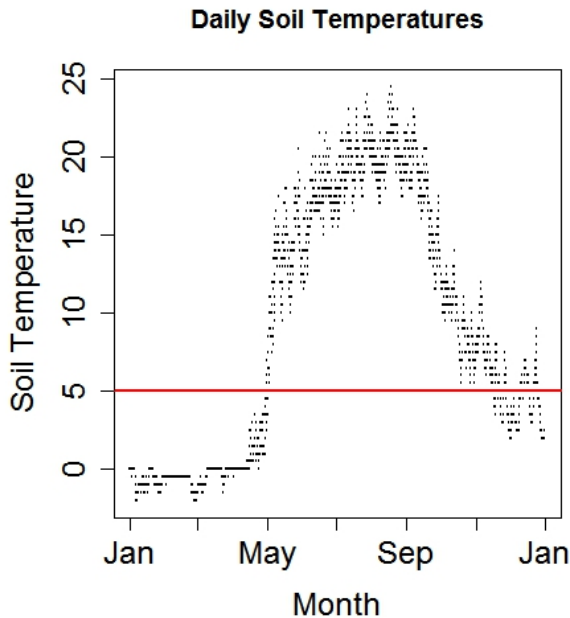
Summary

- ▶ Parasite phenology varies between sites
 - ▶ AU and CW parasite season: weeks 16-32
 - ▶ HF parasite season: weeks 20-32
 - ▶ HF parasite season 2 weeks shorter, but earthworm season appears to be 3 weeks longer at HF
- ▶ Do life history traits (sporocysts/gametocyst) differ between sites?
 - ▶ HF has a higher mean number of sporocysts/gametocyst than AU

Going forward

- ▶ Determine if earthworm season differs between AU and HF
 - ▶ 3 years of soil temperature data for AU and HF
 - ▶ 5°C is when *A. agrestis* begin to hatch, and below freezing is when they die
- ▶ What about Centennial Woods?
 - ▶ CW did not produce gametocysts!
 - ▶ How is CW maintaining the parasite?
 - ▶ Possibly vertical transmission...

Example of Soil Temperature Data



Acknowledgements

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Questions?