Effects of Parasitic Infection on Movement Behavior of Two Different Beetle Species

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Abstract

Infection by parasites can change the behavior of hosts, and in some cases may increase transmission rates of the parasite among individuals. We are interested in how the rat tapeworm (*Hymenolepis diminuta*) affects the movement patterns of its intermediate host the darkling beetle (*Tenebrio molitor*). We are also interested in whether the parasite has an effect on the flour beetle (*Tribolium castaneum*) as a host and if so, is their a similar or different effect between the two beetle species. We artificially infected two different species of beetles with the rat tapeworm and compared movement behavior between infected and uninfected individuals within each of the species. We recorded movement patterns weekly, and compared path complexity between infected and uninfected beetles. Our results have possible important implications for host-parasite interactions and parasite transmission among hosts.

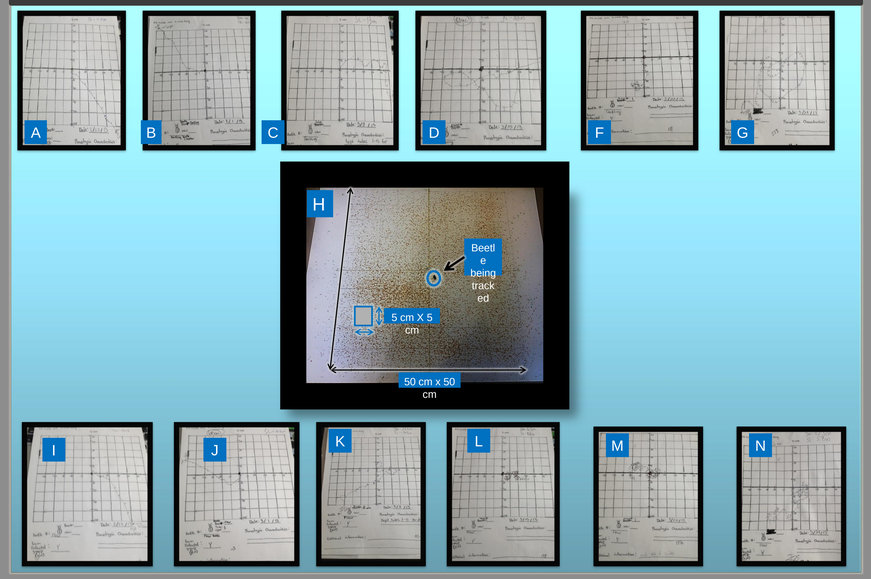
Introduction

- Many parasites have complex life cycles and require multiple hosts, including both vertebrates and invertebrates.
- *T. molitor* beetles are the intermediate host for the tapeworm, *H. diminuta* (rats are the definite host).
- *T. castaneum* beetles are intermediate hosts for the rat tapeworm, however it is not common for them to become infected in their natural environment.
- Most research on this system has focused on movement rates and use of cover on beetle survival and parasite transmission.
- Using our data from six weeks of infection, we are evaluating if path complexity could also influence parasite survival and transmission rates.

Methods

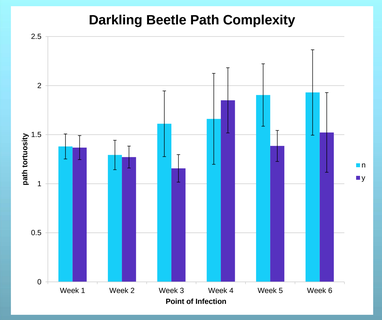
- Beetles were maintained in the lab under uniform conditions.
- Fasted beetles were infected by providing free access to rat feces containing tapeworm eggs for 48 hours.
- Movement patterns were recorded weekly to a 0.5 cm accuracy using an artificial landscape grid (Area = 100 sq cm) and 2 minutes per trial (Figure 1).
- Path tortuosity was calculated with the following formula: Total distance moved / shortest distance between start and end points.
- A t-test was used to compare path tortuosity between infected and uninfected beetles for each week.

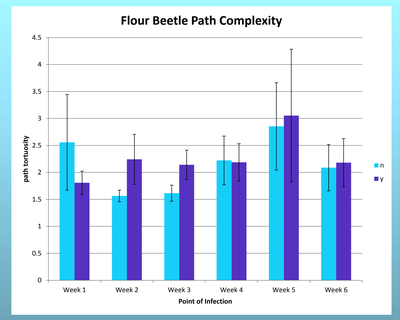
Figure 1. The artificial landscape grid used for tracking beetles (H) and examples of movement paths from weeks 1 (A, I), 2 (B,J), 3 (C,K), 4 (D,L), 5 (F,M), and 6 (G,N).



Results

Figure 2 and 3. Means and standard errors for path complexity of infected (y) and non-infected beetles (n).





Statistics

- Infection did not influence path complexity for any of the six weeks (*T. confusum:* week 1: t = 0.82, d.f. = 18, *p* = 0.42; week 2: t = 1.36, d.f. = 17, *p* = 0.19; week 3: t = 1.7, d.f. = 18, *p* = 0.11; week 4: t = 0.06, d.f. = 17, *p* = 0.95; week 5: t = 0.14, d.f.= 17, *p* = 0.89; week 6: t = 0.15, d.f. = 18, *p* = 0.88) (*T. molitor:* week 1: t = 0.1. d.f. = 18, *p* = 0.95; week 2: t = 0.12, d.f. = 18, *p* = 0.91; week 3: t = 0.23, d.f. = 17, *p* = 0.82; week 4: t = 0.33, d.f. = 18, *p* = 0.74; week 5: t = 1.46, d.f. 18, *p* = 0.16; week 6: t = 0.69, d.f. = 18, *p* = 0.5).

Discussion

- Increasing path complexity was observed over time for infected versus uninfected beetles.
- Path complexity could increase the beetle's odds of predation, with important implications for parasite transmission rates.
- Other studies have evaluated how the parasite influences the darkling beetle's ability to search out cover to avoid predation[1] or movement velocity of the beetle when infected versus uninfected[2].
- Past flour beetle studies have looked at the effects of parasite infection on coprophagic activity[3].
- A larger sample size of both beetle species and more tracks are needed to better evaluate path complexity.

Conclusion

- **We are considering the possibility of further experiments, and will make a decision after evaluating and comparing past data from other trials.**

Acknowledgements

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Literature Cited

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[2]Sheiman et al. 2006. Naturwissenschaften 93: 305-308.

[3]Evans et al. 1992. Canadian Journal of Zoology. 70: 2311-2314