

Title – Ectosymbiotic relationships between the Appalachian brook crayfish (*Cambarus bartonii*) and the Branchiobdellidan, *Cambarincola ingens*.

Program of Study – Zoology

Presentation Type – PowerPoint

Mentor Name and Email – Kyle Harris, M.S. - kjharris@liberty.edu

Student Name and Email – Thomas Holman – tpholman@liberty.edu

Category – Experimental (Basic)

Abstract:

Crayfish are a keystone species in aquatic ecosystems. It is important to study their relationships with other invertebrates in order to learn more about the crayfish's role as a regulator. The Appalachian brook crayfish (*Cambarus bartonii*) has been shown to have an ectosymbiotic relationship with branchiobdellidans (e.g. *Cambarincola ingens*). However, it is not entirely clear what the extent of the advantages and disadvantages might be in this symbiotic relationship. Recent research suggests that at moderate levels the worm density can be mutualistic (i.e. cleaning symbiosis) and at high levels it can be parasitic (Brown et al., 2012; Skelton, 2015). Additional research suggests a tendency for worms to colonize medium to large sizes of crayfish in greater abundance than juvenile crayfish (Skelton, 2015; Skelton et al., In press). Crayfish were collected from a local first order stream. The worms were removed with forceps and the twelve crayfish were split evenly into control and experimental groups. Then all twelve crayfish were submerged in a 10% MgCl₂-hexahydrate solution to remove any remaining worms from inaccessible areas. *C. bartonii* in the control group were placed in individual ten gallon tanks without a *C. ingens* inoculation. The *C. bartonii* in the experimental group were inoculated with four *C. ingens* and then placed in individual 10 gallon tanks. Over the course of twenty weeks, it was shown that the control group with no *C. ingens* grew at a faster rate than the experimental group with four *C. ingens*. After the growth rates were gathered, dissolved oxygen was the next area of focus. A cleaning symbiosis in the gill chambers between *C. ingens* and *C. bartonii* would suggest that crayfish with moderate worm densities may be able to uptake more dissolved oxygen as bacteria are actively cleaned off of gill filaments. An increase in dissolved oxygen (DO) uptake could be one of the advantages of this cleaning symbiosis between *C. bartonii* and *C. ingens*. In order to test DO uptake, the crayfish were placed in a 1L Erlenmeyer flask with a Vernier optical dissolved oxygen probe. The dissolved oxygen data was collected on a Vernier LabQuest2 over four hours with ten minutes in-between each data collection. The data was then analyzed in Excel and the control and experimental slopes were compared to each other. The crayfish in the control group had a higher dissolved oxygen uptake than the experimental group. This data suggests that the *C. ingens* were not beneficial to the growth and dissolved oxygen uptake of *C. bartonii* in the lab setting.

Christian Worldview Statement:

My Christian worldview has been fundamental to my research process here at Liberty University. In the beginning, God created everything and everything was in a perfect state. After the fall in Genesis 3, things became imperfect. When I look at the symbiotic relationship between crayfish and branchiobdellidans I see an imperfect relationship. The relationship has been shown to benefit both individuals in some cases, but often times it can be seen as a parasitic relationship where the worm is feeding off of its crayfish host. I believe that this is a result of the fall in Genesis 3. When I think of this relationship between crayfish and branchiobdellidans I believe that it can be a neutral, good, or bad relationship. I truly believe that before the fall these two organisms got along in perfect harmony, but since we are living after the fall we are seeing the negative effects of this relationship. I would like to find the optimal number of branchiobdellidans to maximize growth rates in order to visualize what life for the crayfish may have been like before the fall. My biblical worldview has driven me to examine the relationship between crayfish and branchiobdellidans in order to better understand how and why a symbiotic relationship can and will switch to a parasitic relationship so easily. Having this Christian worldview has made it easier for me to explain the results of my research because most people, whether they believe in God or not, realize that we live in a broken imperfect world. This research allows me to visualize and present one of the closest examples that I can think of for a 'perfect symbiotic relationship' in an imperfect world.