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Reflective essay: *A beekeeper's guide to Varroa destructor*

I could not have predicted that a writing project would give me much revelation, but throughout my research process, I gradually realized reality was on a different path from my initial pessimistic expectations. Since I had never done research of this scale, even in high school, the process was daunting. I eventually narrowed my research prospects to investigating threatening honey bee pathogens and as my research proceeded, I found that I was highly motivated to find root causes and physiological explanations for my questions. It was in this mindset where I began to genuinely enjoy writing about research for reasons outside of maintaining a grade.

That's not to say I experienced no shortcomings, however, as I struggled greatly with managing the countless resources available. I would not have maintained a positive mindset on research without guidance. A combination of OWRC librarians, UW library websites, and Professor Ghasedi expanded my research techniques to take advantage of proxy bookmarklets, boolean operators, citation searching, and of course, research databases. It quickly became apparent why these combinations were superior to standard search engines once I needed in-depth discussions of honey bee pathogens. Among these techniques, I found UW library search and boolean operators to be the most reliable in returning diverse, yet relevant information throughout the process. These two methods allowed me to begin gathering a collection of papers I found valuable.

The first paper I chose to read was a mini-review of various bee pathogens by Elke Genersch. I ascertained that the *Varroa destructor* parasite is of high threat—inflicting greater damage, economic costs, and viral vector potential compared to other known bee diseases. Upon seeing its destructive nature, I decided to devote my efforts to learning about the mite. I wondered, what makes the *V. destructor* pathology so invasive? I needed more thorough information on topics Genersch's mini-review briefly introduces. As such, I sought to understand the biology and symptoms of *V. destructor* next.

Branching off of the references Genersch provided, I found related papers discussing the biology and control of *V. destructor*. I selected Peter Rosenkranz's article to closely read given its detail and length. I took note of the mite's life cycle, behavior, and effects on honey bees,

learning its evolutionary history and errors in taxonomy during the process. However, I quickly ran into a problem while researching the biology of *V. destructor*.

Many peer-reviewed sources relevant to my topic were understandably not written for the layman. As a result, I found it incredibly difficult to properly summarize and reflect on a reading session when I could not understand its jargon. I asked myself several times if it was worth it to understand every word, wondering if I had overestimated my boundaries. More importantly, if I had trouble reading and summarizing a paper, it would be difficult for my audience to read my summary. The process of interpreting dense information for an informal audience and ascertaining relevant information from the irrelevant are some of the greatest challenges I faced during my research. As such, I concluded I should always try to maintain the big idea of a paper in the face of complex readings, which proved to be difficult at the time.

Thus, I decided that my next step should be familiarizing myself with general knowledge and terminology surrounding honey bees, but done efficiently as opposed to brute memorization. Quick skims of more research journals allowed me to determine the honey bee processes *V. destructor* influences. These became the processes I focused on learning. Instead of referencing peer-reviewed journals, I relied on popular, but credible internet sources like National Geographic, as unlike *V. destructor*, the biology of the honey bee has been consistently studied over longer periods and it would be easier to read pieces written for the layman.

After, I returned focus to *V. destructor*, now with appropriate background knowledge. This time, however, I was looking for modern studies to verify my knowledge up until this point and to identify effective control methods absent in some older research. Surprisingly, I found a significant inconsistency through citation searching Rosenkranz's article. Multiple databases and papers linked to a relatively recent PNAS publication by Samuel Ramsay. Its title caught my eye: *Varroa destructor feeds primarily on honey bee fat body tissue and not hemolymph*. Of the several peer-review studies I'd read prior to this publication, every single one established that *V. destructor* consumed hemolymph, and I took it as fact. Even numerous popular sources indexed by Google will repeat this falsehood. As for its significance, Ramsay's findings are highly relevant regarding *V. destructor* control methods as it explains some studies' failures—the hemolymph chain-citation of the last few decades prevented a targeted treatment.

On control methods, Rosenkranz's paper states that "real biological and effective treatment methods do not exist", which prompted me to ask: Does it exist now? Despite reading

numerous *V. destructor* studies, I had yet to discover the ideal treatment Rosenkranz describes. Many methods are either ineffective by themselves or dangerous for honey bees. I referenced older research with more modern ones and saw a common trend—sustainable treatment methods often varied in efficacy across each study. I concluded that an IPM approach is currently one of the best options for beekeepers, where various methods of treating mites are rotated or used in combination over time.

I believe the continued diversity and number of studies is an indication that researchers and governments treat *V. destructor* as a serious economical, ecological, and welfare issue. While many academic journals are information dense and heavy in terminology, it fills in for the nuance that popular sources lack. I left this experience with a newfound appreciation for the research process, as I thoroughly enjoyed shaping my understanding—an experience that would be absent without the right guidance and databases. When different research techniques revealed new knowledge, I felt a certain sense of accomplishment in knowing I had answered my own questions.

That being said, growth as an author and learner overlap as both require us to take context, rhetorical choice, and natural curiosity into account before and after constructing our pieces. Without realizing it, I had been continuously asking questions, refining them, and planning my process accordingly while documenting my results. The habits I developed during my research will be brought with me to the future. It was a good feeling seeing my writing come together, and it was a wonderful feeling knowing that I had, without a doubt, grown as an author and learner.