CHAPTER 3 EUROPEAN CORN BORER: THE RELATIONSHIP BETWEEN STORED RESOURCES AND DIAPAUSE TIMING

3.1 Background

According to the National Oceanic and Atmospheric Administration, 2016 was the warmest year on record and temperature increases are expected to continue through the year 2100. [25, 26, 27]. As seasonal temperature increases warm summers will are expand, cool winters will contract, and temperatures during the spring and fall will become less predictable [28, 29]. For insects exposed to the environment, variation in temperature and daylight hours can affect the availability of nutrition, mates, and habitat. To be successful, animals must monitor external environmental factors and respond to changes in those factors that become too stressful. Many temperate dwelling insects protect themselves from the unfavorable seasons by entering diapause before the environment becomes unfavorable [1].

Insects in diapause can survive for months exposed to harsh conditions and typically without access to nutrition by lowering their metabolic activity and suspending their development [30, 3]. Before the environment becomes unfavorable insects prepare for diapause by accumulating and storing nutrients in the form of lipids, proteins, and carbohydrates [1]. In addition to surviving diapause, after diapause ends insects must have enough energy remaining to meet the anabolic requirements for development, metamorphosis, repair, and post-diapause activities like reproduction [3, 4]. Insect performance is influenced by the thermal conditions they experience. Warmer winter temperatures due to climate change could increase their metabolic activity during diapause draining nutrient stores [31, 32, 33, 4].

Ostrinia nubilalis (European corn borer) presents a unique opportunity to understand how insects might be affected by warmer winter temperatures. European corn borer exists as at least two naturally segregating strains with unique diapause genotypes and each genotype expresses different diapause lengths. The "long-diapause" strain experiences a longer warmer diapause as it enters diapause earlier in the fall and exits diapause later in the spring. The opposite is true for the "short-diapause" strain who enters diapause later in the fall and exits diapause earlier in the spring. Comparing nutrient stores between larvae with the long diapause and the short diapause genotype could explain how insects might build up additional nutrient reserves to survive diapause as winter temperatures rise.

Hypothetically, larvae experiencing a relatively long warm diapause will store more nutrients prior to the onset of diapause. If long diapause European corn borers are to survive their warmer longer diapause then I predict the long diapause genotype in turn will store more lipids in preparation for diapause than larvae with short diapause genotype. Prior to the onset of diapause and during diapause, fat stores were measured and larvae with the long diapause genotype were found to be larger and with greater fat reserves compared to larvae with the short diapause genotype. These results suggest that nutrition management prior to the onset of diapause and during diapause during warmer winters. As temperatures continue to rise selection might favor insects best able to increase their fat stores in a way similar to European corn borers with the long-diapause genotype

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Insects in diapause can survive for months exposed to harsh conditions and typically do so without access to nutrition by lowering their metabolic activity and suspending their development [30, 3]. Before the environment becomes unfavorable, insects prepare for diapause by accumulating and storing nutrients in the form of lipids, proteins, and carbohydrates [1]. In addition to surviving diapause, after diapause ends insects must have enough nutritional resources remaining to meet the anabolic requirements for development, metamorphosis, repair, and post-diapause activities like reproduction [3, 4]. Insect metabolism is influenced by the thermal conditions they experience. Warmer winter temperatures due to climate change could increase insect's metabolic activity during diapause, thereby draining nutrient stores [31, 32, 33, 4].

Ostrinia nubilalis (European corn borer) is an excellent model to understand how insects might be affected by warmer winter temperatures. European corn borer exists as at least two naturally segregating, genetically distinct strains with unique diapause genotypes where each genotype expresses different diapause lengths. The "long-diapause" strain experiences a longer warmer diapause as it enters diapause earlier in the fall and exits diapause later in the spring. The opposite is true for the "short-diapause" strain that enters diapause later in the fall and exits diapause earlier in the spring. Comparing nutrient stores between larvae with the long diapause and the short diapause genotype could help explain how insects might build up additional nutrient reserves to survive diapause as winter temperatures rise.

I expect that larvae experiencing a relatively long warm diapause will store more nutrients prior to the onset of diapause. If long-diapause European corn borers are to survive their warmer longer diapause then I predict the long diapause genotype in turn will store more lipids in preparation for diapause than larvae with short diapause genotype. Prior to the onset of diapause and during diapause, fat stores were measured and larvae with the long-diapause genotype were found to be larger and to contain greater fat reserves compared to larvae with the short-diapause genotype. These results suggest that nutrition management prior to the onset of diapause and during diapause during warmer winters. As temperatures continue to rise, selection might favor insects best able to increase their fat stores in a way similar to European corn borers with the long-diapause genotype. WHAT ABOUT THE IDEA THAT YOU MAY SEE A SHIFT IN THE PREVALENCE OF THE LONG-DIAPASUE GENOTYPE IN WARMER FIELD CONDITIONS? - sorry caps lock got stuck on inadvertently.

This draft is more to the point and heading in the right direction. However, it does need more fleshing out with salient points to the ideas here. You should find some references that state ideas that overwintering reserves may be important under climate change. Flesh out this idea that we know reserves may be important to being a climate change winner or loser. Give examples from other systems to ground the reader in the ideas you are discussing.