* ~~Changing climate 🡪 increased temps~~
  + ~~Increased temps 🡪 increased seasonal temps~~
  + ~~Increased seasonal temps 🡪 increased growing seasons~~
  + ~~Increased growing seasons 🡪 increased insect generations~~
  + ~~Increased insect generations~~ ***~~can lead to~~*** ~~pest pressure~~
  + ~~Increased pest pressure 🡪 increased damage~~
  + ~~Increased damage 🡪 increased management~~
  + ~~Increasing management~~ ***~~requires an understanding how insects will respond~~***
* ~~Responding to climate 🡪 winners and losers~~
  + ~~Losers 🡪 less genetic variability and extinction~~
  + ~~Winners 🡪 through~~ *~~redistribution and adaptation~~*
    - ~~Redistribution 🡪 range expansion or shifting~~
      * ~~Range expansion 🡪 pest insects in novel habitats~~
      * ~~Pest insects in novel habitats 🡪 effects food security~~
    - ~~Adaptation 🡪 mechanisms: colonization, fitness~~
      * ~~Colonization vs extinction~~
      * ~~Changes in fitness 🡪 Mean of fitness vs variance of fitness~~
  + ~~Evolution 🡪 starts with plasticity in phenos~~
  + ~~Phenotypic Plasticity 🡪 shifts in dormancy;~~ ***~~could be a way insects mitigate the effects of a changing climate~~***
* ~~Plasticity in Dormancy 🡪 response to environment~~
  + ~~Response to environ 🡪 preparing for reduced resources~~
  + ~~Diapause is Preparative 🡪 genetically determined diapause~~
  + ~~Genetically determined diapause 🡪 physiological events~~
    - ~~Physiology changes 🡪 survival of diapause~~
      * ~~diapause 🡪 protection from environment~~
      * ~~diapause 🡪 accumulated resources~~
* ~~Storing enough energy 🡪 accumulated resources~~
  + ~~Accumulating resources 🡪 shifts towards storage~~
  + ~~Shifts toward storage 🡪 types of energy~~
    - ~~Fats 🡪 reservoir of energy and water and hormone molecules~~
    - ~~Proteins 🡪 reservoir of energy, amino acids, tiny machines~~
  + ~~Response to environment 🡪 possible effect of higher temp~~
    - ~~Latitudes and photoperiod~~
  + ~~ECB are a great model for this type of study~~
* ~~Why European corn borer, why diapause?~~
  + Current pest
  + Clinal distribution indicative of adaptation
  + Genetically distinct diapause phenotypes
* Impotance of this study…
  + Modeling evolution of species
  + Pest control 🡪 exploit traits to disrupt diapause phenotype

*Satchels:*

*Dan was talking about how the derivatization may not be totally necessary…. He thinks if we can acquire some peak information from the ELSD and get some good separation we may be able to use that as a replacement and just report the data as a quantity. This would reduce the amount of steps and more importantly, would be a faster means to an end.*

*THe intention of my experimentayion is to quantify the amount of triglyceride produced between the different phenotypes and technically, using the LC I will be able to quantify the TAG production. But personally I wanted to add the identification part. I think that by identifying the TAGs it will more fully characterize the nature of the increased lipid production.*

*Sittting here I am thinking about the total lipid content. As a functional comparison should there be an effort made to quantify/identify the rest of the lipids in the “total lipid matrix”?*

*Written*

*Make the point about how this is happening in the temperate regions also “arctic insects could be recast as high north temperate insects” and use that language to discuss how thiese types of responses to climate change are happening everywhere*

*Edit: bet hedging describes the range of phenotypes that can be expressed from a single genotype.*

*Diapause example: one female partioning her offspring such that while they are all capable of entering diapause, there are individuals that will enter diapause and others that will not. However, they all carry the genotypic capacity to respond to diapause stimulus with diapause phenotype.*

*The bet made is such that by having a range of phenotypes expressed from a distinct genotype, those expressed phenotypes will be differentially fit, and the phenotypes with the highest fitness will hedge against variation in the environment*

*Palsticity: is the animal, by nature of being phenotypically plastic, adaptive? Will plasticity evolve, such that animals with less plasticity will gain more plasticity?*

*Is the plasticity already adaptive, if so the animal may not have to adapt to the changing environment. Plasticity could be pre-adapted to climate change.*

*Plasticity is the phenotypic consequence of a genotype in the environment in which it is expressed.*

*if there is enough plasticity, enough variation in the expression in the of a genotype, there could be reduced evolutionary selection on existing genotypes.*

*Adaptation is the change in the frequency of alleles that increases the mean fitness of that population.*

*Changes in gradients is a change in space*

*Changes in temperatures is a change in time*

*Clines: difference along a latitudinal gradient*

*Remove cline and use latitude*

*Critical photoperiod: the quantity of light received during a day that triggers a diapause phenotype in 50% of a population*

In an environment with less variation, phenotypes that vary less will be selected for and could experience higher success because there is no utility in producing variation in a phenotype for which there is no selective pressure. All things being equal, in a variable those genotypes that have more phenotypic variation, could experience increased fitness in a more variable environment by producing variable phenotypes that could be selected for

*Presentaiton:*

* *Reduce experimentation to between phenotypes! But make clear that this is carried out in two different genotypes*
  + *Color code the UZ and BE when talking about experiment*
  + *Limit UZ and BE and refer to diapause and non-diapause*

*More slides to talk about experiment*

*Repeat UZ and BE as a reminder*

*And add why UZ and BE is such a big deal: genotype, clines, etc…… this needs to be added into the experiment section.*

*and photoperiod. seasonal climates and global food security are tenuously bound making a comprehensive approach to dealing with these changes imperative. Farmers and growers must be able to make short-term and long-term management decisions concerning methods, timing, and tools to utilize when planning pest control strategies and climate patterns are an important part of that calculus. with based upon how the climate affects those populations.*

*The consequences of increased temperatures on insect phenotypes can be estimated by understanding the direct relationship between latitudinal changes in temperature, photoperiod, and how insect respond to these changes physiologically.*

*Here in the United States, 92 percent of all the corn acreage is planted with a genetically engineered corn crop that expresses Bacillus thurengensis (Bt) crystalline protein toxin. Bt toxin was developed agriculturally to assist in managing European corn borer corn pest. pressure manage the that can be done to corn by an infestation of European corn borer. For this technology to be effective, farmers need to predict European corn borer infestations (Fernandez-Cornejo et al. 2014). “Studies detailing diapause-associated changes in intermediary metabolism and feeding physiology are needed across taxa with different diapause strategies to expand our understanding of the metabolic processes underlying prediapause reserve accumulation. The goal in this area is to under- stand the underlying neurological and endocrine signaling mechanisms that regulate diapause-associated shifts in feeding patterns and intermediary metabolism.” (unfinished)*

**Diapause and Food Security:** Populations are expected to rise from the 321.2 million to 398.3 million people here in the United States (Population Reference Bureau 2015). Farmers depend on the predictive nature of these seasonal cues to determine when to plant, chemically treat, and harvest their field crops to meet the food demand of the nation. As temperatures warm, insect pests are expected to respond with increased growth rates, longer seasons, and increases in populations. These additional factors will stress an already stressed system and managing the effects of these pressures will necessitate the use of more chemical pesticides and result in increased crop losses.

Food, mates, water, shelter; these are all resources that organisms must manage to be competitive and survive within their environment, so how is this accomplished? During periods of food abundance one can intuit how managing it can be understood. Simplistically, when available food concentrations are higher than the amount of food required for an organism to survive, they will either consume just enough resources to survive or they will over consume. The dynamics of survival during times of food scarcity is not as simplistic but can be understood in general terms. Overcoming resource decline in most cases leads to different types of dormancy but the intensity, preparation, and duration of that dormancy are all able to be modulated to meet the specific requirements of an organism’s current environment. Organisms experiencing environments with reduced resources can cope with these stressful periods by migrating to locations where resources more readily available. Another way organisms compensate for these resource poor times is by storing more resources during resource rich times to last through the stressful period.

Changes in food, water, oxygen, and temperature can all have direct effects on the immediate developmental state of an organism. Quiescent dormancy is an organisms immediate response to these types of environmental changes. This type of dormancy is not genetically predetermined and while it does reduce the activity of an organism, its metabolic activity is relatively constant (effect of chilling and reduced oxygen and how insects respond to these types of changes… useful and old example in drosophilla). Diapause is a state of dormancy that is initiated in advance of shifting environmental conditions. This type of dormancy is generally precipitates from environmental cues such as light or temperature. Diapausing insects use these environmental cues to initiate physiological changes that function as to protect the insect from the seasonal absence of resources. The genetic programming that is initiated when diapause is induced can result in the acquisition and storage of more resources necessary to survival. (unfinished)