**Introduction**

* Climate change
  + Extreme climates and temperate environments
    - Places at the extremes of seasonal temperatures
      * Shifts in temperature will be more intense
    - Places with more temperate seasonal temperatures
      * Shifts in temperature will be less intense
        + Seasons at high latitudes will look like the seasons of lower adjacent latitudes
  + Seasonal warming and agricultural crops
    - Longer growing seasons
  + Seasonal warming and phytophagous insects
    - Plant eating insects gain more active time in the field
* Response of pests to climate change
  + Extinction and Diversification
    - Possible result of extinction
    - Result of diversification
  + Invasion
    - Possible outcome for invasion
      * Results of this Pest range increase
      * Increased pest competition
      * Pests at lower latitudes could see an increase in range as higher latitudes become warmer
      * Increased host plant access
      * Could see generations
      * increased pest pressure
      * Increased cost to growers
* Why use ECB as a model
  + ECB is an important agricultural pest
    - Annual damage to crops
    - Costs to manage pest
    - Life history
    - Discovery of clinal pattern of ECB as a function of climate
      * Latitudinal distribution of ECB
      * Figure 1b: DOI: 10.1111/jeb.12562
      * Seasonal influence on voltinism
      * Bi- and Univoltine strategies
  + Prediction opportunity
    - Pest range expansion
    - Pest pressure
    - Similar pests
  + We can answer big questions about extinction and diversification
* Speciation during climate change
  + Responding to climate changes (Williams 2014)
    - Specialized diets = less flexiable
    - Univoltine with fixed seasonal timing = less flexiable
  + How does this effect development for univoltine organisms and bivoltine
    - Having a one generation stragety makes adaptation
* **Benefits of studying**:
  + Weight loss via changing resource management,
  + life extension via suppression of development,
  + pest control via diapause manipulation,
  + pest population monitoring

**Genetic Importance of ECB**

* + Genotypes of ECB and how they relate to the different physiologies
  + Diapause timing pf ECB
  + Using models like *Ostrinia nubilalis* offer a biological view of resource management that is unavailable using *Drosophilia melanogaster.*
  + Discuss how resource management questions are asked: Does

**Ecological Seasonality:**

* What are seasons generally and how does its regularity or irregularity effect ecosystems and the organisms in those ecosystems
  + Talk about how phytophagous insects depend on timing their life cycles on food availability
    - Organisms deal with fluctuations in their environment to maintain homeostasis and to be competitive. Temperature is a ubiquitous stress that most all organisms actively regulate against. Temperature variance can be environmentally gradual, seasons that change from warmer to cooler as the year progresses, days that become warmer then cooler as the sun rises and falls. This type of cyclic temperature stress is predictable and organisms must synchronize their life histories to compliment theses stress cycles. can that pattern use to make life history decision.

To be competitive in one’s environment organisms must be able to utilize resources when they become available. Integrating predictable cues from the environment, organisms have evolved life history strategies that include ways to deal with these predictable cycles of resource abundance and resource scarcity. When resources are not around

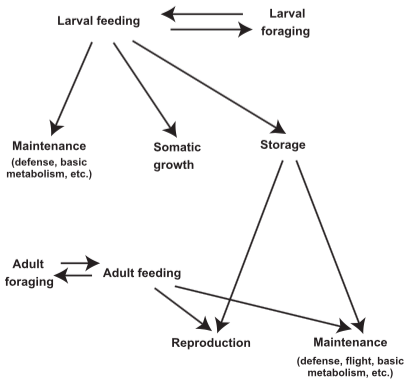
* + - Of the diapausing insects that do not feed after diapause must be able to not only survive the period of diapause but they must also be able to undergo adult pupal metamorphosis. Some insects prepare for this
* Talk about the confluence of life history timing and seasonality and resource availability
  + Why are seasons so important for insects to detect?
  + How can insects detect changes in their environment?...hormones
  + What effect does sensing these environmental changes have on the insect
    - Migration or diapause or both
      * Migration: Danaus plexippus is an example where both migration and a type of dormancy occurs. During autumn these animals mitigate the effects of their harsh environments through migration. To accomplish this migration, Monarchs migrate in a state of diapause, characterized by reduced responsiveness to reproductive and vegetative stimuli and increased lipid storage.
      * Diapause:
    - Finally discuss diapause as one of those choices

**Diapause:**

* In general, what is diapause
  + Programmed dormancy brought on by: temperature, light, or a combination of the two
  + Occurrence of diapause in across taxa
    - In Danaus plexippus migrating monarchs are in a state of reproductive diapause where
  + Protective state for when resources are low/ environment is inhospitiable
  + Hallmarks include reduced metabolism/respiration
  + Can be obligatory or facultative
* What does diapause look like in my model
  + Generally what do ECB face leading up to diapause
  + Cue that induce diapause
  + Life stage that diapause is signaled
  + Life stage that diapause is induced
  + Physiology of my system at diapause induction. Feeding, metabolism, respiration
  + End on a discussion about the proliferation of fat and proteins

**Fat Body:**

* How resource affect life histories of insects
  + CL Boggs: The schematic below is a resource allocation framework provided by CL boggs that does well to summarize the priorities of feeding stages of insects.



* What is the biology of the fat body
* The role of the fat body leading up to diapause
  + Lipid and protein production