2010

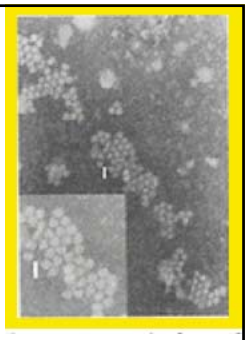
2010 Cranberry Management Update: Molecular Detection of Parasites in Bumblebees

Anna Morkeski
UMass Amherst, morkeski@psis.umass.edu

Highlights of CCD research findings

- **Heavy focus on:**
  - **Varroa mite,**
  - **Pesticides,**
  - **Queen breeding –resistant strains of honey bees**
- **Debate over whether migratory bees are less healthy than stationary bees**
  - **Some work to show negative physiological effects, but may not translate into economic difference**
  - **Pathogens and parasites are problematic, but not consistently**
  - **Hard to say whether renters will be economically impacted this year.**

RNA interference (RNAi)



- New technology to change the world
  - Very safe method for disease control
  - Highly specific
- Method
  - Gene specific, naturally occurring materials that can be fed to bees to inhibit gene expression of parasites and pathogens
- New Market- First use to be approved by FDA
  - Beeologics has several products to improve pollinator health
    - Viruses
    - Nosema
    - Varroa mite

Beeologics

Bumble bees

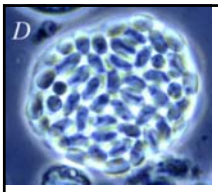
- Bumblebees pollinate about 15% of our food crops (valued at $3 billion)
- Close to 50 species in US and Canada
- Commercial rearing was on the rise in the early 1990's

Initiative to regulate bumble bee importation

- Professor Emeritus Robbin Thorp, an entomologist at UC Davis
- Monitored bumble bee populations
  - Found that two species disappeared
- Hypothesized that commercial rearing had something to do with it

UCDAVIS UNIVERSITY OF CALIFORNIA

Harry H. Laidlaw Jr. Honey Bee Research Facility



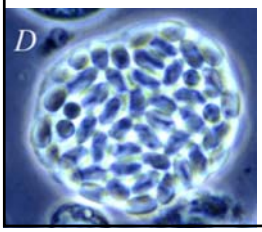
Initiative to regulate bumble bee importation

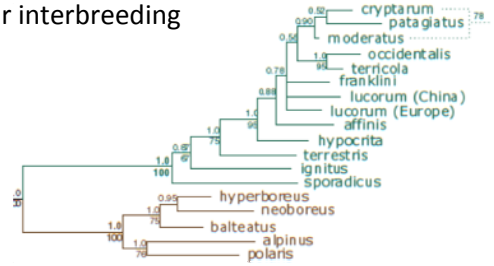
- 1997: Koppert had outbreak of *Nosema bombi* that wiped out west coast commercial bumble bee stock
  - Biobest suffers also
- USDA Animal Plant Health Inspection Service (APHIS) allowed queens to be shipped to Europe for domestication from 1992-1994
  - Queens were reared alongside a common European species
- Thorp believes North American species acquired an exotic strain of *Nosema bombi* at this time.

KOPPERT BIOLOGICAL SYSTEMS

Bumble bee decline

- The bumble bee species that suddenly became rare all belong to the same sub-genus.
  - Used as evidence to suggest that pathogen introduction was cause of decline
    - Purely circumstantial
    - No evidence to show that pathogens in populations of wild bees are the same strains as recovered from Europe
    - Pathogen outbreak in rearing facilities could have been from native queens used for interbreeding





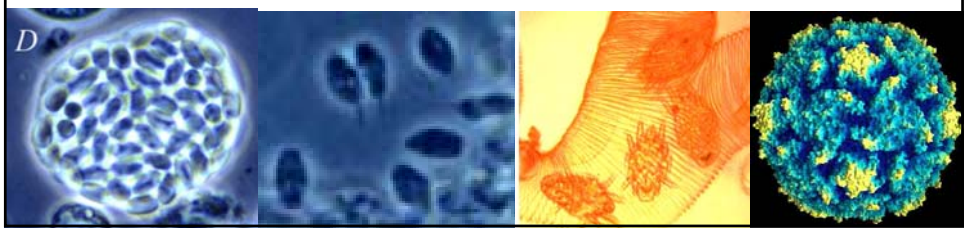
Managed Pollinator CAP (Coordinated Agricultural Project)
A National Research and Extension Initiative to Reverse Pollinator Decline

- Molecular techniques
  - Pathogen detection (PCR)
  - DNA sequence comparison
  - Possible transmission patterns
    - Important to look at more than 1 gene
- Stationary Apiary
- Pesticides

USDA

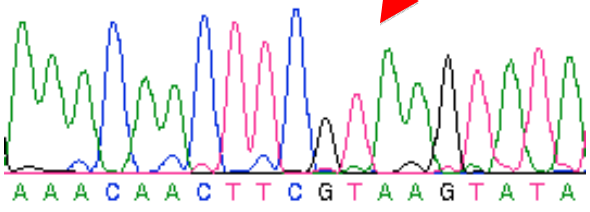
Our Hypothesis

- Techniques currently used don't detect differences between populations so transmission patterns can't be discerned.
- We can create tools that provide us with the right data to answer some of those questions
- Same approach can be applied to many pathogens and parasites including:
  - •*Nosema bombi*
  - •*Crithidia bombi*
  - •Tracheal mite
  - •Viruses



Methods

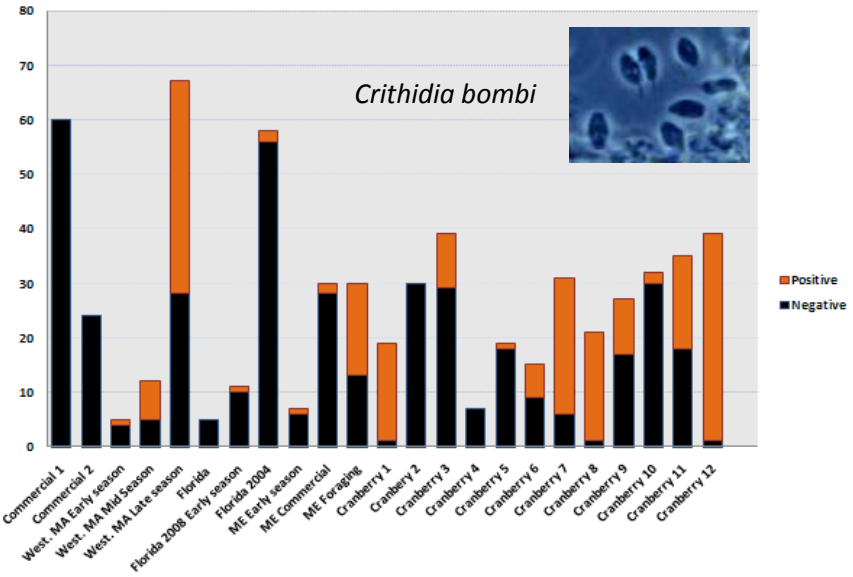
- Sampling
- Sample preparation
- Nucleotide purification
- PCR
- Sequencing



Collections

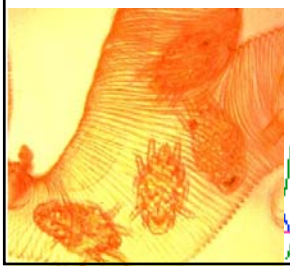
- 2008
- 2009
- Stationary Apiary
  - Honey bee pathogens can potentially infect bumble bees that forage in the same location
- Biobest
- Koppert

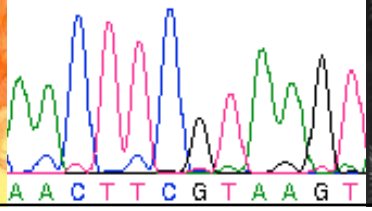
2008 Highlights

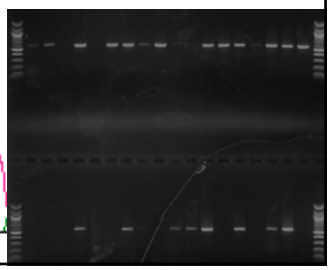


2009 Highlights

- Made protocol for detecting tracheal mite
- Detected in Koppert bees
- Very rarely detected in wild collected bees
  - Except near where commercial bees are potentially used

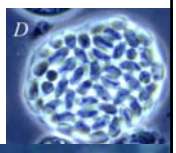




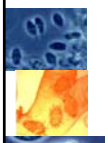
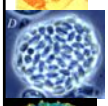
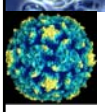


2009 Highlights

- *Nosema* only found at 7 of 35 sites tested
- *Crithidia* found at 20 of 35 sites tested
- Koppert
  - *Nosema bombi*
  - Tracheal mite
  - DWV
- Biobest
  - *Crithidia bombi*



Stationary Apiary

- **Minnesota (98 bees)**
  - No *Crithidia bombi*
  - No tracheal mite
  - Only one bee with *Nosema bombi*
    - Only bee of that species in the collection
  - # of bees positive for DWV

Stationary Apiary



- **Maine (37 bees)**
  - 23 of 37 have *Crithidia bombi*
    - 7 of 9 species of bumble bees represented
  - No tracheal mite
  - No *Nosema bombi*
  - No bees positive for DWV

  - 9 different species of bumble bee including 2 very rare species
  - No commercial bumble bees used in the area for approximately 15 years

Invasive bumble bees

- Enter ecosystems and compete with native bees (larger and disease resistant)
  - Direct competition
    - Nesting sites
    - Food resources
    - Mates
    - Reproduction – socially parasitic workers
  - Reproductive disturbance
    - Commercial colonies can reproduce earlier in the season, males try and mate with whatever queens they can find

Bumble bees like:

- Nesting sites:
  - Piles of debris
    - Mulch, rocks, old containers
  - Abandoned rodent homes
  - Flowers (common weeds) when crops aren't flowering
    - Dandelions
    - Goldenrod
    - Clover