

**42<sup>nd</sup> Annual Framingham State University  
Biology Student Research Conference  
Friday - December 10, 2010**



The Thornton Award is given each year in memory of **Shaun Thornton**, a biology major who died in a motorcycle accident in 1993, several days after receiving the award for the best presentation at the 24<sup>th</sup> Annual Framingham State University Biology Student Research Conference. The award is given to the presenter(s) of the best oral and/or poster presentation of their research.

### The Thornton Award Winners:

- 1993 Jason Fitzpatrick
- 1994 Diane Caunt
- 1995 Amy Donoghue  
and Terry O'Connell
- 1996 Gianna Troiano
- 1997 Jim Uthoff (oral)  
James Griffin (poster)
- 1998 Julie Ploof
- 1999 Scott Andrea
- 2000 Mark Cooperman (oral)  
Deidre Osborne (poster)
- 2001 Virginia Rainville
- 2002 Azra Ahmed
- 2003 Scott Alconada
- 2004 Anita Lovely
- 2005 Heather Paquin
- 2006 Jeane Webster
- 2007 Jennifer Bertolasio
- 2008 Carol Furnari
- 2009 Andrew Grassetti

Welcome to the 42<sup>nd</sup> Annual Framingham State University Biology Student Research Conference. Each year our students present the results of their independent research at this conference. These presentations represent the culmination of a year of hard work. Through this first-hand research experience, our students come to understand the scientific process and appreciate the complexity and diversity of biological systems.



**The 2010 Faculty of the Biology Department**



## Edwin Castillo

### Long Term Efficacy of a Phosphite + Surfactant Spray Application Against the Chestnut Blight Fungus (*Cryphonectria parasitica*)

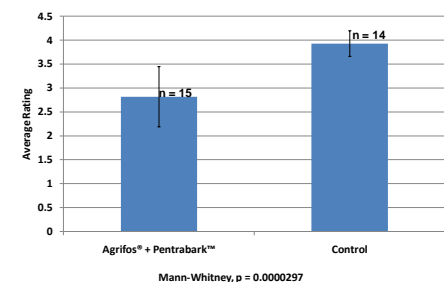
The American chestnut tree (*Castanea dentata*), once a central part of American economy and culture, was effectively eliminated from forests in the early 20<sup>th</sup> century by the invasive chestnut blight fungus (*Cryphonectria parasitica*). Infected American chestnut trees have the ability to re-sprout; however, these sprouts are usually infected and killed before reaching sexual maturity. A treatment using the phosphite Agrifos® mixed with the surfactant Pentrabark™ applied as a spray directly on the bark, demonstrated the potential to significantly suppress the growth of *C. parasitica*. Research using this treatment, on different pathogens, indicates that effects were still evident 18 months after initial application. This study examines the long term efficacy of the Agrifos® + Pentrabark™ treatment to suppress the growth of the chestnut blight fungus. The trees treated with the Agrifos® + Pentrabark™ spray as part of a study 12 months before were re-inoculated using two strains of the fungus (*C. parasitica*). The resulting cankers were measured and assigned a rating, based on the severity of the infection. Canker sizes on the treatment trees were not significantly smaller when compared to the controls. However, the majority of the control trees died leading to a smaller sample size. The resistance ratings of the treatment group were significantly better than the ratings in the control group. The results collected from this study suggest that the Agrifos® + Pentrabark™ treatment is only moderately effective 12 months after initial application.

#### Evaluating efficacy by measuring infection area

- To record canker size:
  - Bark was scraped off to expose dead tissue
  - Outline was traced on transparent paper
- Calculated area (cm<sup>2</sup>) using outline
- Problems:
  - Cankers merging
  - Trees completely dead



#### Agrifos® + Pentrabark™ treatments had significantly better ratings than controls





**Molly Champagne**  
Control of Chestnut blight  
with phosphite fungicides

The Chestnut blight, caused by the fungus *Cryphonectria parasitica*, has nearly eliminated mature American chestnut trees in the Eastern United States. Phosphite fungicides are used against many plant pathogens, but have not been tested against the Chestnut blight. This study tested the phosphite Agri-fos<sup>®</sup> on native American chestnut trees in Upton, Massachusetts. Trees were sprayed with an Agri-fos<sup>®</sup> and Pentra-bark<sup>®</sup> solution before being inoculated with strains of *C. parasitica*. Pentra-bark<sup>®</sup> is a surfactant and is needed to get Agri-fos<sup>®</sup> through the trees' bark and into the vascular system. The cankers that formed were measured to determine how effective Agri-fos<sup>®</sup> would be at suppressing the blight. Agri-fos<sup>®</sup> and Pentra-bark<sup>®</sup> were also tested in the laboratory against *C. parasitica* grown on potato dextrose agar and the growth of the fungus was measured. In both experiments Agri-fos<sup>®</sup> reduced the growth of the fungus, and could be helpful as a fungicide for the Chestnut blight; however more research is needed to study the effects of Pentra-bark on the Chestnut blight. Having a fungicide for the Chestnut blight will make it possible for the American chestnut trees to re-gain their economic value they once had.

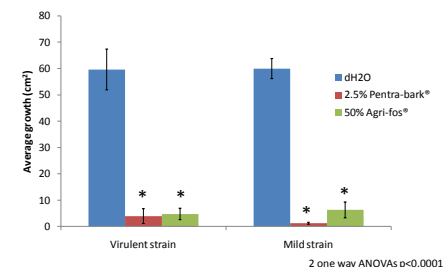
#### Tree preparation

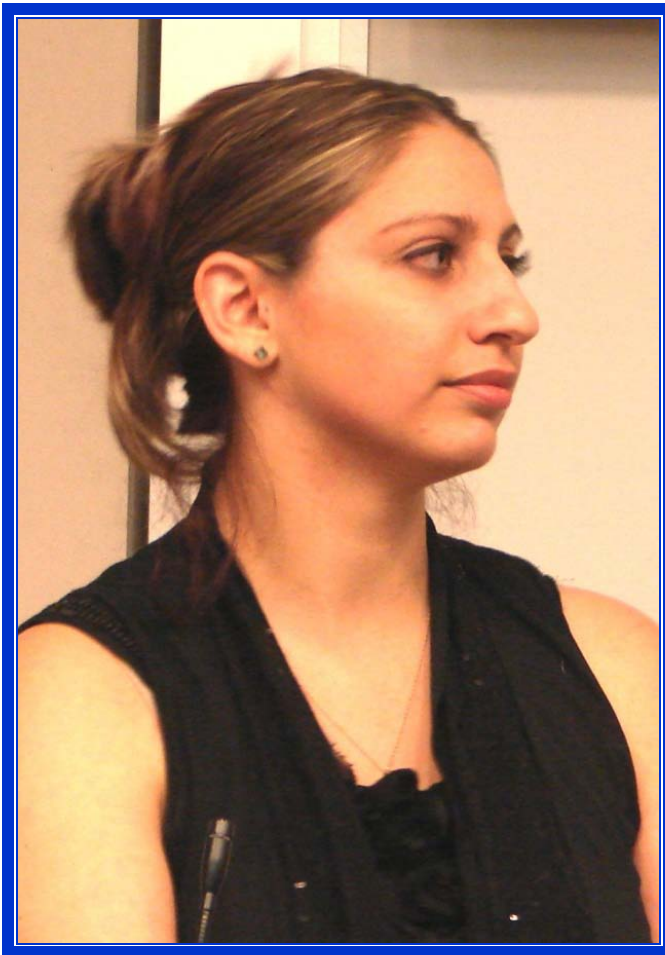
- Treated mid June
- Sprayed each tree with 200ml of treatment or control
- Waited 12 days before inoculation



www.tacf.com

#### Growth inhibited by Agri-fos<sup>®</sup> and Pentra-bark<sup>®</sup>



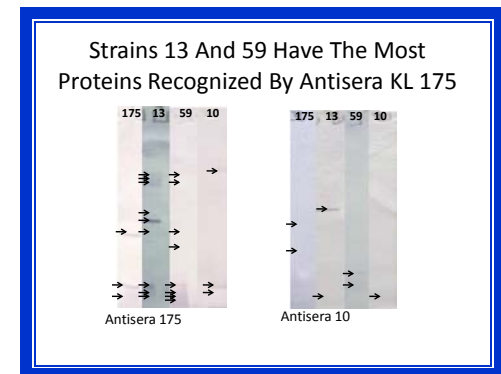
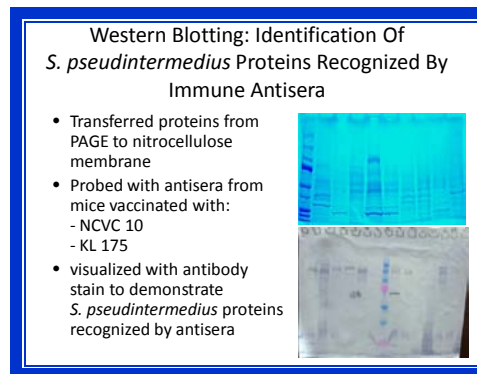


**Christine Diaz**

Potential of

*Staphylococcus pseudintermedius*  
surface proteins for a vaccine  
to prevent canine pyoderma

Canine pyoderma, caused by the bacterium *Staphylococcus pseudintermedius*, is a common disease among canines. Due to the increase in antibiotic resistance it would be beneficial to create a vaccine against this bacterium. A conserved surface protein on *S. pseudintermedius* strains could be used as an effective vaccine. Using western blotting the different strains were probed with two different sets of antisera. The two antisera were collected from previously vaccinated mice. One set of antisera was made with *S. pseudintermedius* strain NCV 10 and the other with strain KL 175. Antisera KL 175 recognized more proteins than antisera NCV 10. It was also found that antisera KL 175 recognized three common surface proteins. These three proteins can potentially be used as a vaccine to protect against a majority of strains of *S. pseudintermedius* and prevent canine pyoderma.



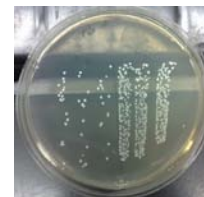


**Juan Herrera**  
Induction of Tolerance  
Rather Than Protection  
by Vaccination in a Mouse Model  
of Canine Pyoderma

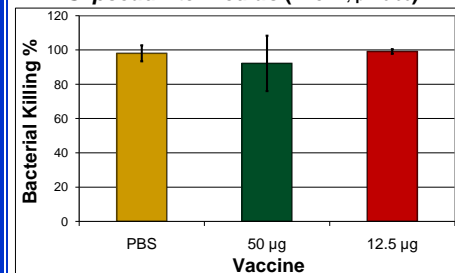
Canine pyoderma is a skin disease of dogs caused by infections with *Staphylococcus pseudintermedius*, and is commonly characterized by necrosis of the skin. Current treatments for pyoderma consist of antibiotics that are costly and inefficient; improper administration of antibiotics has selected for antibiotic resistant strains of bacteria. Antibiotic treatments do not provide long term protection. As a result it is imperative that a vaccine that prevents the occurrence of these infections be developed. Although vaccine treatments have been approached, these vaccines are autogenous vaccines meaning they are made for each individual occurrence. A potential vaccine is the purified capsular polysaccharide from *S. pseudintermedius* poly-n-acetylglucosamine (PNAG). Goal was to determine if the efficacy of the vaccines is altered when vaccination schedule is changed in a mouse model of pyoderma. Thirty mice were separated into the three treatment groups which were vaccinated a total of three times according to their treatments of PNAG, killed *S. pseudintermedius* strain KL175, and phosphate buffered saline. But instead of all the vaccinations occurring three weeks apart like in a preliminary study that showed protection; the third vaccination occurred twelve weeks after the second vaccination. Vaccine efficacy was challenged by subcutaneously injecting  $2.1 \times 10^6$  cfu/50 $\mu$ l of live *S. pseudintermedius* strain KL175. Efficacy of the vaccine was measured by calculating the average percent of bacteria killed from the initial challenge dose. Mice vaccinated with PNAG were not protected (-273% killing) and the group autogenous vaccine model also were not protected (-87% killing) were not protected. When compared to the placebo group which were also not protected (25% killing) the vaccinated groups had a higher amount of bacteria recovered. These results suggest that a change in the vaccination schedule may have inadvertently suppressed the immune systems in the mice and induced a form of tolerance.

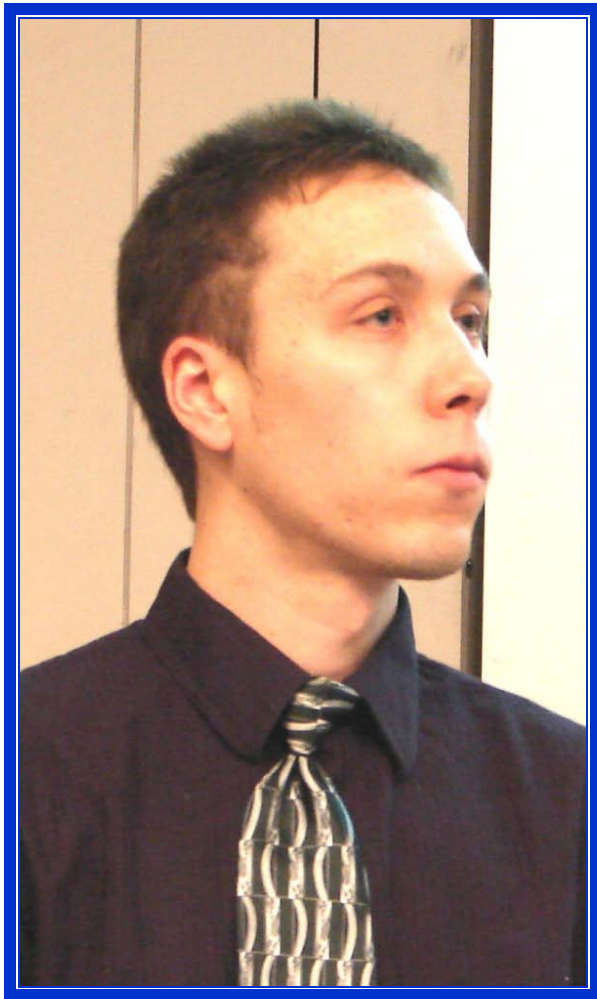
Determination of Vaccine Efficacy

- Mice were sacrificed
- Pyodermic lesion removed
- Homogenized the tissue
- Diluted the tissue
- Plated onto growth media
- Calculated number of bacteria recovered



Vaccines did not protect against *S. pseudintermedius* (ANOVA,  $p = 0.30$ )

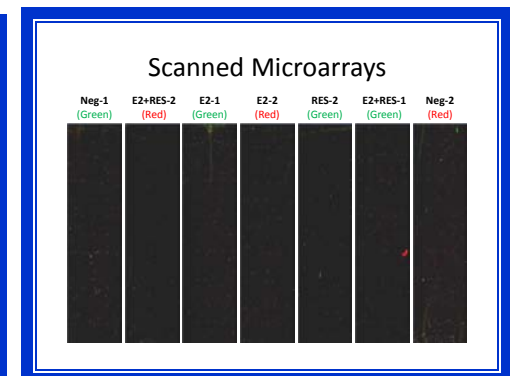
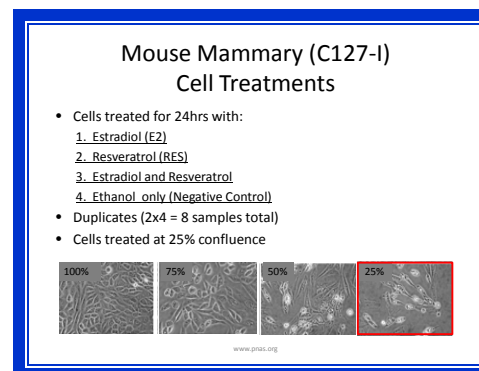




**Mike Legge**

Resveratrol-induced changes in  
gene expression patterns  
in C127-I mouse mammary cells

Resveratrol, found in red wines, is suggested to help reduce the risk of breast and prostate cancers by interacting with estrogen receptors to change the expression of downstream estrogen-responsive genes. Using microarray analyses, we explored resveratrol-induced changes in gene expression patterns in C127-I mouse mammary cells to further understand the anti-carcinogenic potential of resveratrol. C127-I cells were treated at 25% confluence with estradiol, resveratrol, both estradiol and resveratrol, or neither as a negative control. Cellular mRNAs were harvested from treated cells, reverse-transcribed into cDNAs, fluorescently labeled with capture tags for Cy3 (green) and Cy5 (red), and then concentrated using Amicon concentrators. Blocked mouse chip microarrays were hybridized once to apply the concentrated cDNAs and a second time to introduce Cy3 and Cy5 dendrimers, which bound to the capture tags causing them to fluoresce. As expected, the microarray scans portrayed red, green, and yellow fluorescing genes; however, a relatively low percentage (< 15%) of the 38,000 genes fluoresced. The low quantities of fluorescing genes led to difficulties during the microarray gridding process, preventing further analyses. Low gene fluorescence was likely a result of the low RNA yields obtained through RNA isolation. As the pilots for microarray experimentation at Framingham State University, our data emphasizes the importance of high RNA yields prior to cDNA synthesis. Therefore, future microarray experiments will treat cells at 75% to increase the RNA yield during isolation.





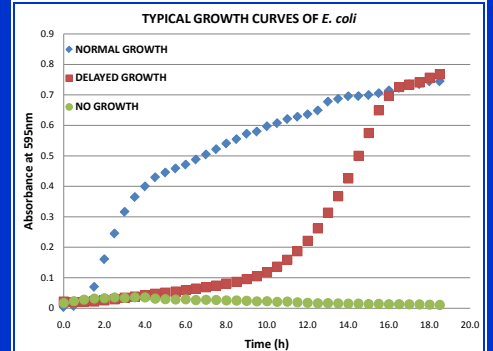
**Wesley Luo**  
Properties of

## Antimicrobial Peptide Fragments

Antimicrobial peptides (AMPs) are part of the innate host defense mechanisms. They are typically short (12-45 amino acids long) and are positively charged. They have a broad-spectrum of activity against microbes. The N-terminal region of the three peptides is capable of forming an  $\alpha$ -helix. This  $\alpha$ -helix is the structure that forms pores in the cell membranes, called the barrel-stave model. However, literature also suggests that these same helices are capable of binding to the cell membrane in a carpet-like fashion until they form vesicles, called micelles. This formation of micelles is called the carpet model. Both models essentially disrupt the integrity of the cell membrane, killing bacteria. Several AMPs have been found to be effective against clinical isolates in cystic fibrosis patients. This suggests a possible treatment, or therapy program, for cystic fibrosis patients suffering from chronic infections. They are not currently used due to the high cost of production. Fragments make for an attractive alternative because fragments are shorter and therefore much cheaper to produce. In this study, fragments of Sheep Myeloid Antimicrobial Peptide – 29 (SMAP-29), Cecropin P1 and Pleurocidin were tested against *Escherichia coli* ML35. Fragments were synthesized in respect to the different regions of a peptide (N-terminal, inner, C-terminal). The N-terminal regions of the three peptides, the C-terminal region and the inner region of SMAP-29 were capable of inhibiting growth of *E. coli* ML35. These results support previously published literature in that the N-terminal region of the peptides contains the active site that binds to bacterial cell membranes and that SMAP-29 also has a binding region at the C-terminus. Because the shortest membrane-spanning peptide is longer than these peptide fragments, the carpet model is the most plausible mechanism of action of the two.

### TESTING ANTIMICROBIAL PROPERTIES OF PEPTIDE FRAGMENTS

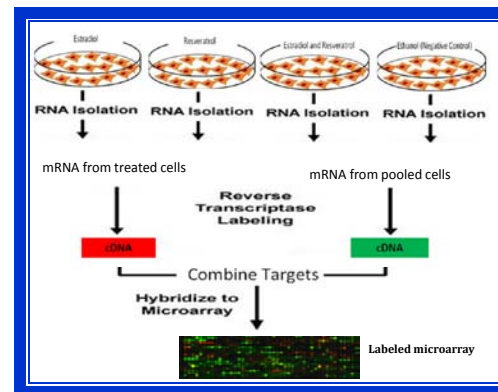
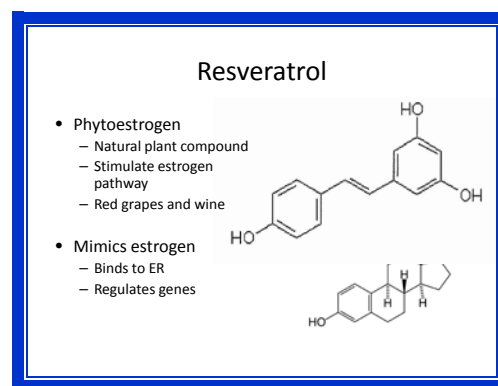
- Using microtiter plates, each fragment was added to growth media containing *Escherichia coli*
- *E. coli*, growth media and buffer were also used as controls
- Using a spectrophotometer, bacterial growth was measured every 30 minutes for 14-18 hours





**Jennifer Lynch-Kupan**  
**Microarray Analysis of**  
**Gene Expression in Cultured Cells**  
**Treated with Estradiol and**  
**Resveratrol**

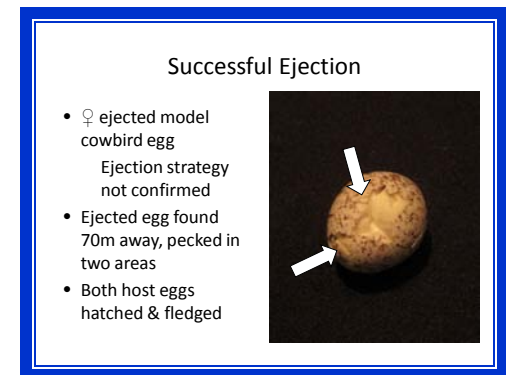
In estrogenic tissues, estrogens bind to estrogen-receptors (ERs) and initiate a signaling pathway that begins with changes in expression of estrogen-responsive genes. Resveratrol, a phytoestrogen commonly found in the skins of red grapes and red wine, has been shown to act as an agonist of the ER and either up-regulate or down-regulate gene expression. Research has examined resveratrol's role in cancer progression and cancer prevention. It suggests that resveratrol may protect against cancer progression. In this study, I hypothesized that resveratrol may be able to protect against cancer due to regulating genes that would otherwise be mis-regulated, such as tumor suppressors and oncogenes, that are normally regulated by estrogen. We used a cDNA microarray analysis to examine the expression of ER-responsive genes when C-1271 mouse mammary cells were treated with estradiol, resveratrol, and estradiol + resveratrol. Resveratrol and estradiol might activate and regulate the same genes; however, we concluded that to perform this study in the future a higher yield of RNA would be recommended. Overall, further studies will be important because the expression of genes mis-regulated during cancer progression and the effects resveratrol has on expression. More specifically, these studies will increase the understanding of estrogens affects on cancer progression in addition to potentially looking into resveratrol as an anticancer supplement.





**Renee McDonough**  
Ejection strategies for the  
removal of parasitic cowbird eggs  
by a host species,  
the Warbling vireo (*Vireo gilvus*)

Warbling vireos (*Vireo gilvus*) are the smallest species in North America known to eject parasitic cowbird eggs from their nests. However, there is a conflict in the ejection behavior reported in the literature: one study found strictly grasp-ejection, while another study found strictly puncture-ejection, with males suspected of being less effective ejectors than females. I tested three hypotheses in an attempt to reconcile the controversy in Warbling vireo ejection behavior. I hypothesized that, first, puncture-ejection is more reproductively costly for the host than grasp-ejection, second, females will find and eject eggs more than males, and third, that males are less effective at ejecting eggs than females. I was successful in experimentally parasitizing only one Warbling vireo nest using a model Brown-headed cowbird (*Molothrus ater*) egg. I witnessed egg-ejection by the female Warbling vireo but could not confirm the strategy used. I collected and examined the ejected egg, which had two large holes, but I could not conclude the strategy used. I conclude that Warbling vireos (WAVIs) in northeastern US eject model cowbird eggs, similar to WAVIs in the Rocky Mountain region (although the method remains unknown), and unlike WAVIs along the western coast, which accept them.



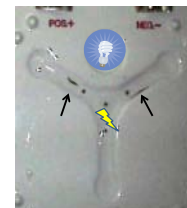


**Jonathan David Merced**  
Effects of *Ginkgo biloba* on  
learning and memory  
in *Dugesia tigrina*

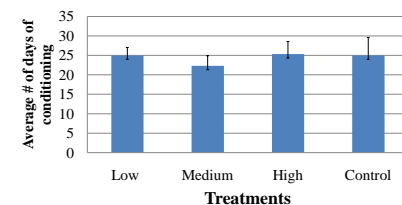
*Ginkgo biloba* (*Gb*) is commonly marketed as a memory enhancing drug. However, various human-based experiments have shown inconclusive results. This study used *Dugesia tigrina*, the common flatworm, as the model organism for examining *Gb* effects on learning. Due to its many similarities in cellular structure and function to the mammalian central nervous system and its ability to demonstrate learning *Dugesia tigrina* provides an excellent model organism. This study utilized classical conditioning, involving the coupling of light and shock to elicit a learned response of moving against the organism's turning bias. *D. tigrina*, commonly referred to as planaria, were housed in various concentrations of *Gb* (22 mg/L, 44 mg/L and 66 mg/L) and their learning rates compared to that of individuals housed in spring water. The data show that the paradigm used was successful in conditioning the organisms, however treatment with *Gb* had no effect on learning in the planaria.

#### Conditioning on a Train-A-Tray

- Train-A-Tray Maze
- Filled with spring water
- Low to no light
- Turning bias determined (5/7 trials = planaria turning bias)
- Coupled light and minor electrical shock → Turn against bias



#### *Ginkgo biloba* did not affect days until conditioning



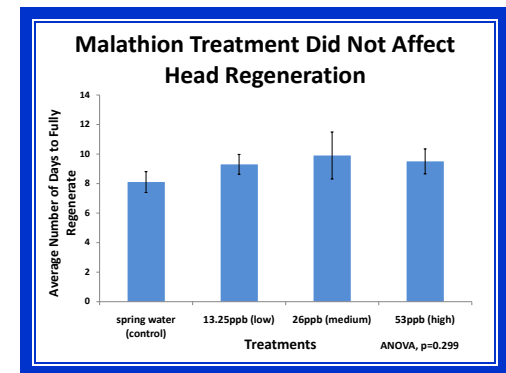
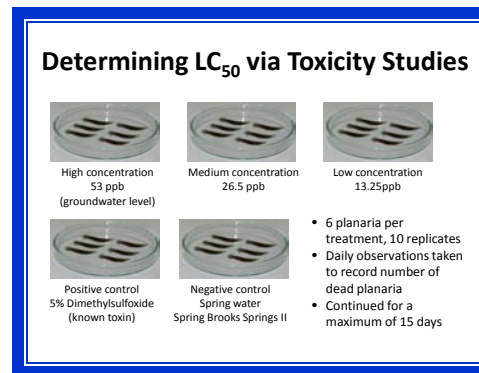
One-way ANOVA,  $p=0.097$



## Le Pham

### The Effects of the Organophosphorus Insecticide Malathion on Freshwater Planaria

Organophosphorus insecticides are commonly applied to the environment to eradicate pests and unwanted species, primarily to prevent destruction of vegetation. However, through improper usage, these synthetic chemicals find a way into our water supplies causing contamination. This class of compounds is known to be hazardous to terrestrial and aquatic organisms, as well as to humans via direct exposure and inhalation. The effects of groundwater contamination were examined using the organophosphorus insecticide Malathion found at groundwater levels of 53ppb. The commercial product Spectracide Malathion™, which is 50% Malathion, was used to examine the effects of Malathion on aquatic invertebrates using freshwater planaria (*Dugesia tigrina*) as model organisms. Due to a relatively high cell proliferation rate and varying sensitivity to toxins, planaria serve as model organisms for both developmental and toxicity studies. The overall toxicity of Malathion was investigated by examining survival rate to various exposure levels. In addition, a developmental study examined the potential effects of Malathion on growth and head regeneration. Both studies expanded a time period of 15 days. From data collection, and statistical analysis, it was concluded that the concentrations of Malathion used (13.25ppb, 26.5ppb, and 53ppb) did not negatively affect the mortality or regeneration rate of the freshwater planaria. Results from this experiment indicated that planaria may be more resistant to Malathion, than other aquatic organisms.

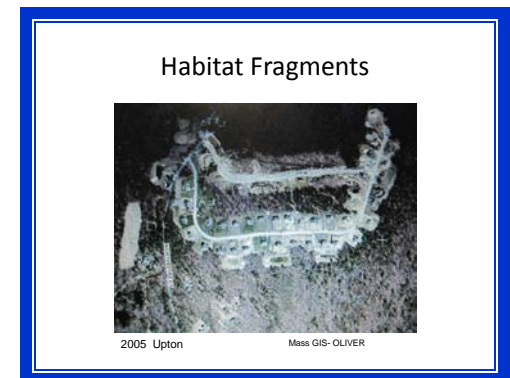
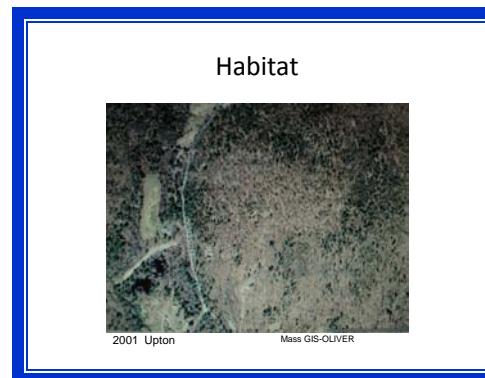




**Sharon Riley**

The Influence of  
Suburban Habitat Fragmentation  
on Wild Bee Populations

Habitat fragmentation has been found to affect many organisms in different ways. It has been thought to cause extinctions in some species, as an extreme, has caused inbreeding in species, such as European Tree Frogs, and has not affected other species as to this extent. There has been controversy in what affect habitat fragmentation has on bees. Some studies concluded that habitat fragmentation decreases the species richness and relative abundance of bees, while other studies find there are no significant impacts of habitat fragmentation. Few studies have examined the impact suburban habitat fragmentation has on wild bee populations. Usually in suburban habitat fragmentation the habitats change their floral composition, removing their wild flowers and replacing them with ornamental flowers. This was a pilot study done in eastern Massachusetts comparing the wild bee populations in habitat fragments (home gardens) to a continuous habitat (conservation lands). After comparing suburban habitat fragments to continuous habitats, I found no significant difference in species richness, abundance, or diversity. There was also a similar ratio in suburban habitat fragments and conservation lands of large winged bees to small winged bees. The small winged bees could find food resources in the fragments and cross the busy roads to find more food resources, if need be. Suburban development did not greatly impact the wild bee populations. Surprisingly, in both suburban habitat fragments and conservation lands there was very low species richness. The species that were present can survive in the suburban fragments, regardless of wing size.





**Sharon Scully**  
Territory defense  
versus nest defense in  
male Warbling vireos (*Vireo gilvus*)

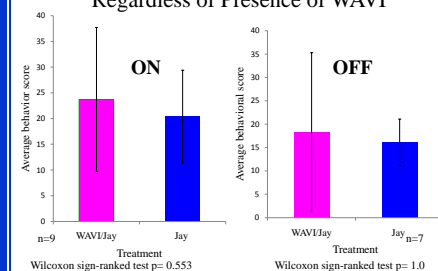
Male birds must find a balance between territory and nest defense during incubation in order to optimize their reproductive success. My study organism, the male Warbling vireo (*Vireo gilvus*) is a territorial bird that also shares the parental care with their mates; meaning they will defend their territories from other male Warbling vireos (WAVIs) as well as defend against nest predators such as Blue jays (*Cyanocitta cristata*). My study examined how the males reacted on and off the nest, to WAVI and Blue jay intruders when presented simultaneously. There were three randomly assigned trials that were performed when the males both on and then off the nest. One trial was with the Blue jay predator, another was with the WAVI, and the final trial was with both the Blue jay and the WAVI simultaneously. I compared the reactions of male WAVIs by creating a behavioral measures index. On the nest, when presented with both intrusions, the males reacted just as aggressive to the Blue jay as to the WAVI. This means the males protected their nests and their territory equally. Off the nest, as predicted the males reacted more aggressively to the WAVI than the Blue jay; the males protected their territory more than their nest. Both on and off the nest, males respond just as aggressively to simultaneous intrusions as to solo intrusions for both the WAVI and the Blue jay. In conclusion, while the males are on the nest they will defend both their territory and nest equally; but when they are off the nest they defend their territory significantly more than the nest.

#### Model and Playback Set-Up

- 5 ft pole, fake tree branch, model
- "Stokes Birding by Ear" audio CD
- 5 minutes played
- Observed from  $\geq 10$  meters



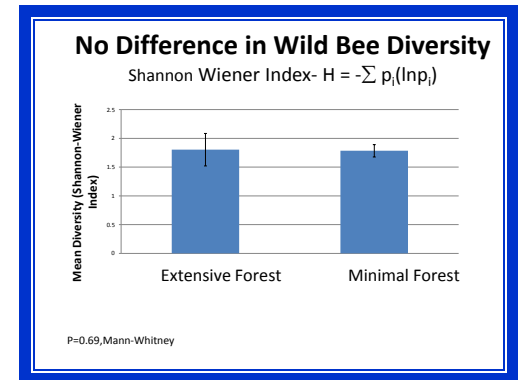
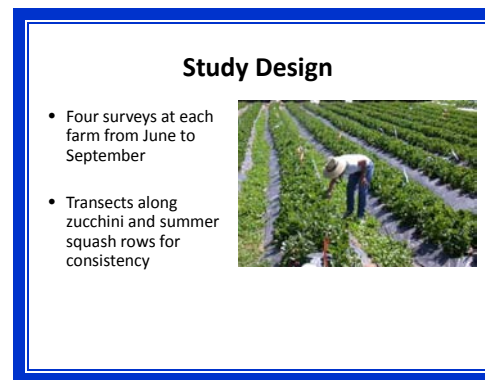
#### Males Respond Equally to Jays Regardless of Presence of WAVI





**Lisa Stasio**  
Effects of Forest Loss  
on Wild Bee Communities  
on Vegetable Farms

Bees (*Hymenoptera: Apiformes*) are the most abundant pollinators and therefore play a crucial ecological and economic role to humans because most agricultural crops require their pollination. Due to drastic declines in managed honey bees (*Apis mellifera*), more research on wild bees is necessary. Wild bees require suitable nest sites as well as abundant floral resources. In order to conserve these important crop pollinators, it is important to determine if farmland, and the surrounding habitat, can support diverse bee communities. I established 10 sites on vegetable farms in eastern Massachusetts, five of which were surrounded by extensive forest and five of which were surrounded by minimal forest, to examine if minimal forest habitat in the surrounding matrix of farms reduced the habitat's ability to support diverse bee communities. I collected 369 wild bees of 25 species. Species richness and wild bee diversity were not significantly different on farms in extensive forest when compared to farms in minimal forest. Both species richness and diversity were considerably low in relation to comparable studies using similar protocols. The sampling method I used was in accordance with a standardized method for collecting wild bees except my study had a smaller sample size and was focused on only one crop, squash (*Cucurbita*). Therefore, future studies, focusing on other crops, and with more study sites, would help scientists understand if the low diversity found is due to poor habitat quality or due to limitations in my study.





**Sara Tumminelli**

Is the Graded Alarm Call of  
Black-capped chickadee  
(*Poecile atricapillus*) due to the Predator's  
Size or the Predator's Diet type?

Many species of birds produce alarm calls to warn conspecifics of danger. However, only a few studies have determined what information is encoded in these alarm calls. In one such study, Black-capped chickadees (*Poecile atricapillus*) produced alarm calls which differed in the number of “dee” notes depending on the predator species. However, it is not known whether the chickadees respond more intensely to the size of the predator or to the predator’s primary diet preference. I investigated this topic by comparing Black capped-chickadee alarm calls in response to models and song playbacks of a Red tailed hawk (*Buteo jamaicensis*, a mammal-eater), a Northern goshawk (*Accipiter gentilis*, a bird-eater), and a Ruffed grouse (*Bonasa umbellus*, a seed-eater as a control). I chose these three species because they are approximately the same body size. I hypothesized that the number of dee notes in the Black-capped chickadee alarm call will change depending on the perceived severity of the threat. Presumably, over evolutionary time, chickadees have been more strongly selected to avoid bird predators than mammal predators. Therefore, they should perceive bird predators as more of a threat than mammal predators. I predicted that the chickadees will sing more “dee” notes in response to the Northern goshawk than to the Red tailed hawk and that they will not sing at all to the Ruffed grouse.

## Functionally Referential

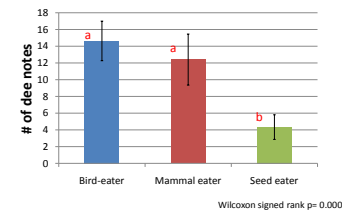
- Change based on predator type
- Black capped chickadees: stationary and flying predators
- More dee notes for smaller predators



<http://animal-discovery.com>

Ficken et al. 1978  
Sourd and Ritchison 2009

## Chickadees recognize predators but don't distinguish between diet types







# The Late-Night, Egg Foo Young Collaboration!

