A. Grant Data:

Category: Northeast Regional IPM Competitive Grants Program (RIPM)
Title: Integrated Pest Management of Pest Ants in the Urban/Suburban Landscape
Project Director: Dr. Eleanor Groden
Team Members: Dr. Francis A. Drummond.
Dr. Susan Whitney King
Dr. Carolyn Klass
States Involved: Maine, New York, Delaware
Grant #:
Year Grant was awarded: 2006
Length of the grant: 24 months plus 12 month no-cost extension
Funding Amount: $150,055

B. Non Technical summary

Pestiferous ants in the suburban/urban exterior landscape are often overlooked in pest management programs, but they can cause considerable problems for homeowners, businesses and schools. These problems include a) nuisance and health issues associated with stinging and biting incidences, b) damaging plants directly or through the act of tending Homopteran species, and c) contributing to interior nuisances and structural damage by exterior nesting species. One of these ants, the European fire ant, is an invasive species that has become a serious pest in many coastal communities in Northern New England. Populations have also been found in Massachusetts, Vermont, and New York. A limited amount of information is available on the distribution and management of this species, and with increasing concern for the development of more environmentally friendly techniques to manage insect pest, we developed this project. We proposed to investigate 1) the potential management of *M. rubra* populations around buildings and homes, 2) Survey PCOs, homeowners, master gardeners etc. in the NE to determine the most commonly encountered pestiferous species in the landscape, and 3) develop and distribute region specific information on pestiferous ant species and options for "least toxic" management options.

C. Introduction

Most pestiferous ant management programs focus on structural pest ants, neglecting and underestimating the potential problems that ants in the exterior landscape can cause. The invasion of fire ants, *Solenopsis invicta,* in the southern United States has increased awareness of ants as landscape pests and their effects on public health and the economy. Currently, another fire ant, *Myrmica rubra*, is slowly invading the northeastern United States and causing concern among homeowners, businesses, and communities. Densities of this aggressive, stinging ant can average 1.4 nests/m^2 with 300 to 10,000 foragers per nest. These high densities drive people out of their yards and displace native fauna. A need exists for safe and effective means of managing this pest, with a focus on preventing further spread.

Toxic baits with delayed activity have been found to be effective for managing pestiferous ant population. The delay in activity allows ants to collect the toxicant and feed it to the rest of the colony before they succumb to its effects. Using bait stations to distribute bait reduces the environmental, health, and safety risk sometimes associated with broadcasting baits.

A broader knowledge of ant species considered landscape pests in the Northeast, including the European fire ant, will help us to develop better management strategies. To date, there is not a comprehensive database pestiferous landscape ants in the Northeast. There is also no centralized source of information that the public can access to aid them in identification and management of pestiferous ant species they may come in contact with. We aim to address both of these problems in this study.

D. Objectives

Research

R1) Develop and evaluate "least toxic" strategies for homeowners and businesses for management of European fire ant, *Myrmica rubra*, using bait station strategies.

- **a)** Determine the effective land area serviced by individual bait stations.
- **b)** Determine the time required for successful transfer of bait from foragers to the rest of the colony.
- **c)** Field test the optimal bait strategy for management of *M. rubra.*

Extension

E1) Survey pest control operators in participating states and extension workers throughout the NE region to determine the most common reported species of ant causing problems for home owners, businesses and schools

E2) Develop a web-based key to the common ant pests in the Urban/ Suburban landscape in the NE region

E3) Develop and distribute web-based and printed materials for home owners and businesses (Including control Operators) on common pestiferous ants in the Urban and Suburban landscape and its management

E. Approach

Research

R1 a) *Effective area of bait station:* We examined the area serviced by a single bait station by placing AntPro® bait stations baited with a sucrose solution with florescent dye at infested sites. Foragers were then collected at different distances from the stations over time and processed on TLC plates to determine the presence of the dye. The experiment was conducted at one site in June 2006, and replicated at 4 additional sites in July 2006.

R1 b) *Colony Feeding Study:* Seasonal changes in the rate of transfer of nutrients throughout all life stages in a colony was evaluated by exposing field collected colonies to sucrose, protein and oil based diets marked with a fluorescent dye and sampling members of the colony for presence of the dye after 2-96 hrs of exposure.

Cafeteria Study: We conducted research to examine seasonal variation in nutrients exploited in the field by comparing forager collection of different nutrients (Lipid, Sugar, Protein, and Carbohydrate) embedded in a standard diet matrix in field based choice test.

R1 c) *Field evaluation of bait strategy:* Two field trials were conducted: one on properties on Mount Desert Island comparing the effectiveness of bait stations baited with solid vs. liquid baits compared with broadcast treatments of solid baits; and a second on Squirrel Island, off of Boothbay Harbor, Maine, comparing solid and liquid baits deployed through bait stations. Ant activity was monitored pretreatment and regularly post treatment.

Extension

E1) For the survey, each state received 500 ant sampling-kits before seasonal ant activity began to distribute between PCOs, homeowners, master gardeners etc.

E2) Using the results from our survey we are currently developing a web based pictorial key of the most commonly identified pestiferous ants.

E3) Based on our survey results, we have developed materials for homeowners and businesses on the most encountered pestiferous ant species in New York and Maine.

F. Progress

Research

R1 a) *Effective area of bait station:* Field samples have been collected and analyzed. Results are presented below.

R1 b) *Colony Feeding Study:* Samples have been collected, processed and analyzed. Data is presented below.

Cafeteria Study: Field samples have been collected and analyzed. Results are presented below.

R1 c) *Field evaluation of bait strategy:* Trials are complete. Field samples have been collected and analyzed. Results are presented below.

Extension

E1) In Maine, kits were distributed among pesticide operators (20%), Master Gardeners (10%), Extension Offices (65%), and directly to public (5%). In NY, kits were distributed among pesticide operators (5%), Master Gardeners (20%), Extension offices (65%), and IPM coordinators (10%). The returned ant samples were identified and the sender contacted with the result. We also tracked the nature of the complaints/concerns, frequency of receiving certain species and origin of samples. We have determined which ant species are causing the most concern for landowners in Maine and New York (presented below).

E2) We are currently working with the University of Maine to completely redesign our current *M. rubra* website (http://biology.umaine.edu/fireant/index.html) with several goals in mind.

1. Making the site easier to find. Currently when a concerned landowner searches for *M. rubra* using an internet search engine our site isn't in the top 10 results. We are imbedding codes to make the site more recognizable to search engines.
2. Reducing clutter and unnecessary information.
3. Updating the information on the site to include most current research and results.
4. Adding a blog type section of the site where "breaking news" can be streamed live to the University of Maine homepage.

We are also going to include a web based key of the top four species that cause the most concern for Maine and New York homeowners. The key will be pictorial and easy for homeowners to use and navigate. When a homeowner reaches the end of the key and finds the resulting ant they will receive a short fact sheet explaining the biology, ecological importance and management strategies for that particular species of ant.

E3) We continued to monitor our extension e-mail account Ants.IPM@Maine.edu to channel the information on ants and ant control. We answered ant related concerns; gave information about the ant biology and management options by phone, e-mail, or standard mail. Other extension activities included talks and presentations at PCO meeting, field days with master gardeners, tradeshows for lawn professionals, presentations to School IPM groups, and scientific meetings. Finally, we have updated our fact sheet about *M. rubra* history, behavior, identification and management with the most current management information.

G. Results

Research

R1 a) *Effective area of bait station:* During the first trial, florescent dye was detected in workers at 32 m from the bait station within 24 hours of exposure (Figure 1). However, when this study was replicated at four other sites in a second trial in July, florescent dye was only detected up to 8 m from the bait stations. The proportion of ants positive for the dye decreased significantly with distance from the bait station ($p<0.0001$), and did not increase significantly between 1, 3 and 7 days of continuous exposure ($p=0.65$), and there was no interaction between distance and time ($p=0.56$).

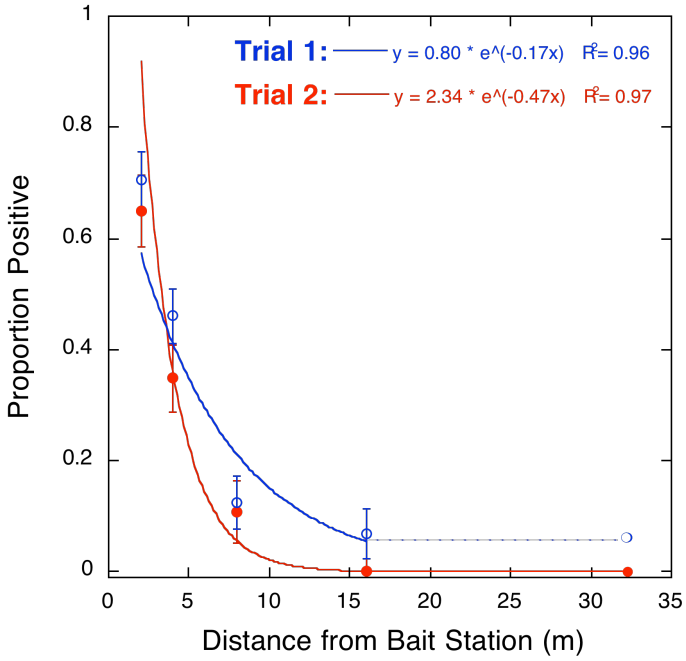

Figure 1. The distance that FB28 Florescent dye delivered in an AntPro® dispenser baited with sucrose solution was detected in M. rubra foragers collected over one week of exposure. Trial 1 was collected at a single site in June 2006; trial 2 was replicated at four sites in July 2006.

R1 b) *Colony Feeding Study:* All diets were detected in all lifestages within the first 2 hrs of exposure and although there was some increase in diet consumption with hours of exposure ($p=0.0007$ for workers, $p=0.02$ for larvae, and $p=0.72$ for queens) all diets generally increased resulting in no interaction (Figure 2). Nutrient consumption did change significantly for all stages with the date ($p<0.0001$ for workers, larvae, and queens) and diet ($p<0.0001$ for workers, $p=0.03$ for larvae, and $p<0.0001$ for queens), but a significant interaction between date and food was only detected in workers ($p<0.0001$). Workers consumed significantly more sucrose than protein and oil diet in May, a greater amount of protein and sucrose than oil in August, and a greater amount of sucrose again in September. These diet differences are reflected in the diet of the larvae and queens fed by workers in May and August, however, overall, significantly more sucrose diet compared to protein and oil diets was detected in larvae and queens. Seasonal changes in the amount of diet fed larvae reflected changes in the size and development stage of the brood (i.e. maturing third instars post-diapause in May and June consumed larger amounts than that observed during subsequent pupation and beginning development of the next generation of smaller first and second instars). Queens were fed increasing amounts of food throughout the season.

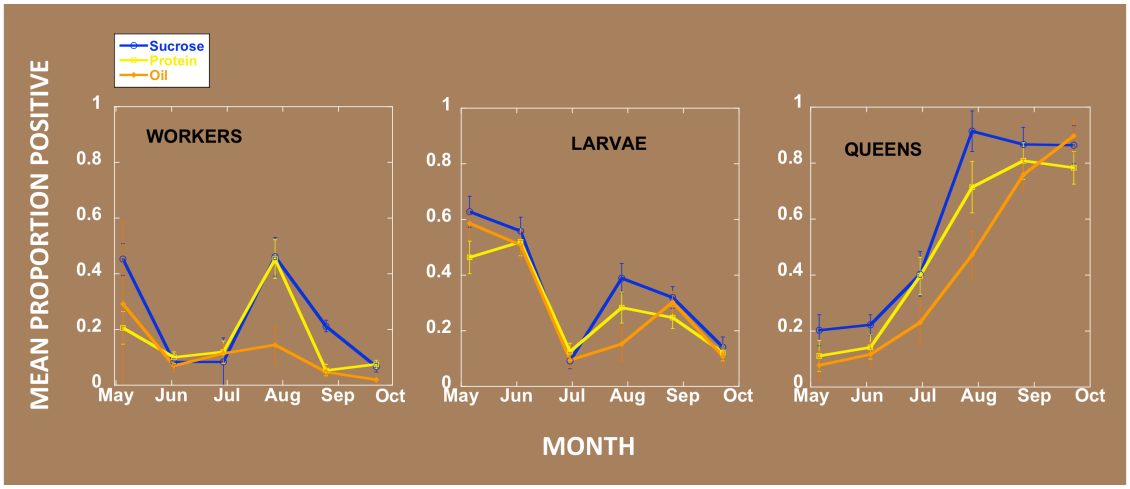

Figure 2. Transfer of single nutrient-based diets (sucrose vs. protein vs. oil) from foragers to other workers, larvae and queens in a M. rubra colony throughout their active season in Maine.

Cafeteria Study: At the start of postdiapause (early May) all diets were collected in equal quantities (Figure 3). By late May, sugar and carbohydrate diets were collected more than protein diet. During the reproductive period (June, July and August) we observed a decline in preference for sugars to a stronger preference for protein. During prediapause we initially observed a strong preference for protein, but by early October, there was no detectable preference between the protein, sugar and carbohydrate diets.

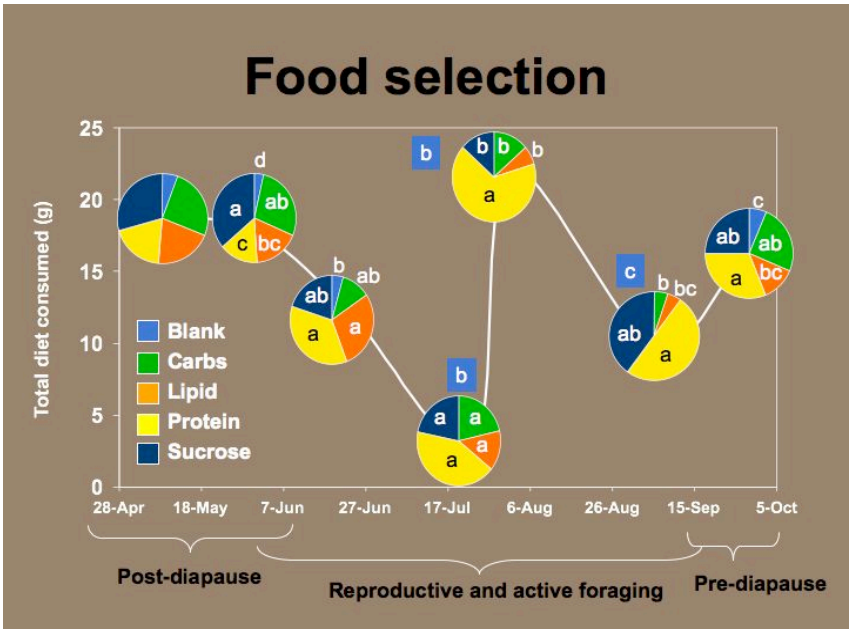

Figure 3. Cafeteria Experiment: Seasonal changes in food preference of M. rubra foragers in field based choice test.

R1 c) In the 2007 field trial on MDI (Figure 4), the most effective treatment was the Advion® fire ant bait, which resulted in significantly lower numbers of foragers after both the first and second broadcast application. Pre-Empt® liquid in AntPro® bait stations also lowered the number of foragers after the first application, but not after the second. Our food recruitment (cafeteria study) suggests that this difference could relate to seasonal changes in relative food preferences of the ants away from sugars. However, colony feeding results indicate that sucrose is consistently fed to all stages of the colony through the active season. Colony phenology sampling indicated that the second application took place during peak pupation. This, in addition to the effects of the first application, may have resulted in a reduced foraging force that limited the amount of toxin returned to the colonies.

The study does demonstrate that either a bait station strategy or a broadcast bait strategy can work to significantly reduce activity of *M. rubra* on infested properties if the right active ingredient and product are used. Thus far the imidacloprid in sucrose bait (PreEmpt®, Bayer) has been the most effective product in liquid bait stations and indoxacarb in a solid granular bait (Advion®, Dupont) has been the most effective broadcast bait. Hydramethylnon (Maxforce®, Bayer) granular bait has been effective in the past, but was less so in our 2007 trial.

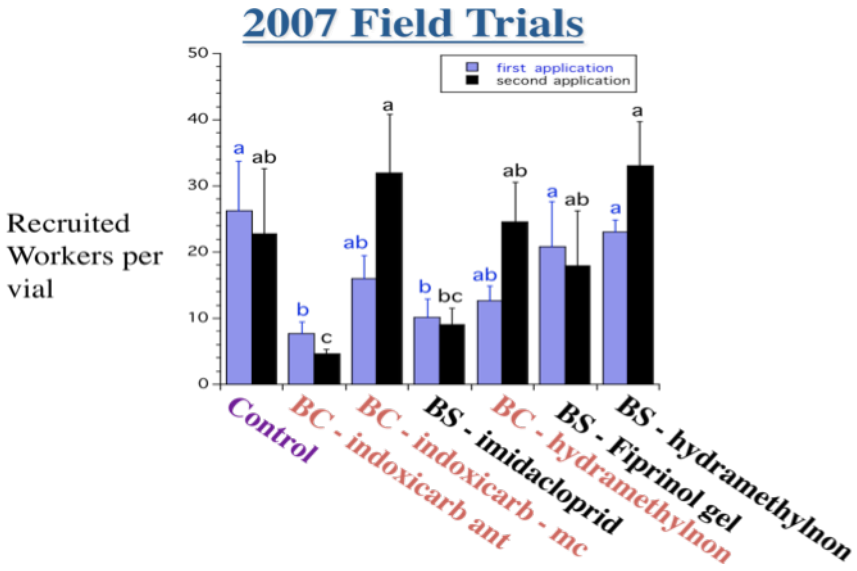

Figure 4. Field trial conducted on infested properties in 2007 comparing the effectiveness of bait station strategies versus broadcast baits for management of M. rubra populations.

In the 2008 field trial conducted on Squirrel Island off of Boothbay Harbor, ME, the bait station strategy with imidacloprid in liquid sucrose bait (Vitis Liquid Ant Bait®, Bayer Cropscience) deployed in AntPro® dispensers reduced ant activity one week post treatment significantly more than the control or the fipronil in a gel bait (Maxforce Ant Gel®, Bayer) in MORBS® (Maxforce Outdoor Refillable Bait Stations, Bayer), which did not differ from the control. As ant populations continued to increase over the summer, the imidacloprid product continued to show reduced ant activity after one month post treatment, at which time the fipronil product also showed significantly lower activity than the control.

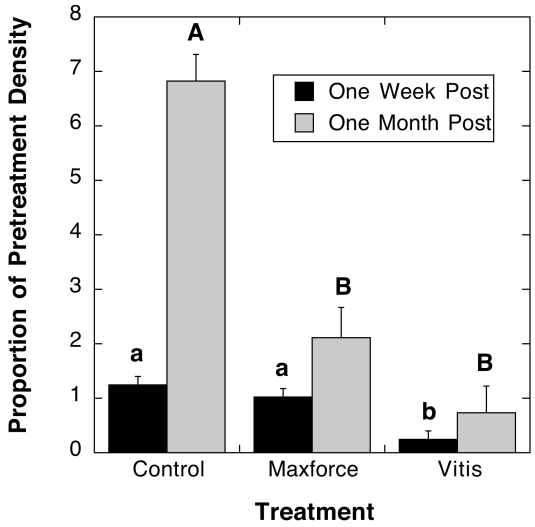

Figure 5. Reduction in M. rubra foraging activity following deployment of two bait station strategies on Squirrel Island off of Boothbay Harbor, ME in 2008. Treatments included fipronil in a gel bait bait (Maxforce Ant Gel®, Bayer) deployed in MORBS® (Maxforce Outdoor Refillable Bait Stations, Bayer), imidacloprid in liquid sucrose bait (Vitis Liquid Ant Bait®, Bayer Cropscience) deployed in AntPro® dispensers, and a control of no bait stations.

Extension

E1) In Maine 17% of mailers were returned (83 of 500), representing 15 of 16 Maine counties. Fourteen of the samples received were from indoor ant complaints leaving 69 samples used for analysis. Most (91%) of the samples originated from privately owned properties and the majority (50) of the samples originated from coastal counties of Maine. Four genera were represented in the samples and the two most common species found in Maine complaint samples were *Formica exsectoides,* the Allegheny mound ant (25 samples) and *Myrmica rubra*, the European fire ant (16 samples). *M. rubra* complaints include stinging, swarming and damaging plants, while the *F. exsectoides* complaints include biting, swarming / worried about invading house, and damaging plants.

In New York, we received 98 outdoor pestiferous ant samples representing 20 of 62 NY counties. These samples included returned mailers and those collected from properties after receiving phone complaints. Most (88%) of the samples originated from privately owned properties and the majority (49) of the samples originated from central NY. Fourteen genera represented in the samples, with the most common pestiferous ant species found in New York were *Tetramorium caespitum* (21 records), *Camponotus pennsylvanicus (*7 records), *Lasius neoniger* and *Tapinoma sessile* (6 records each)

In both Maine and NY, complaints were sometimes not reflective of the potential threat of the species collected. For example, *T. caespitum*, *M. rubra*, and *F. exsectoides* are all unlikely to damage plants, which was a common complaint accompanying samples of these species. *L. neoniger* and *F. exsectoides* are both unlikely home invaders and many people were concerned that these species might become invaders .The need for educational materials on species specific ant biology and their true damage potential is evident in the disconnect between sample species and nature of the complaint.

E2) Our current launch date for the new site is December 15, 2009.

E3) 2007-2009: Developed and updated invasive red ant management information sheet to be distributed through cooperative extension and other outlets.

2008Arevalo, H.A. and E. Groden. 2007. Myrmica rubra. Creature Feature: Publication Number: EENY-410. University of Florida. http://creatures.ifas.ufl.edu/urban/ants/Myrmica_ruba.htm (August 2007). http://creatures.ifas.ufl.edu/urban/ants/Myrmica_ruba.htm

2009: Developed and distributed flier on disposal of organic debris for ant infested neighborhood in Orono; updated ant management sheet and distributed directly to homeowners and to extension colleagues for further distribution.

Public Presentations:

August 2006. European Fire Ant, Update. Bar Harbor Conservation Committee, Bar Harbor, ME.

March 15, 2007. European Red Ants. Recertification Training: Structural General and Food Processing, Brewer, ME

August 7, 2007. The Dreaded European Fire Ant. Bar Harbor Garden Club, Bar Harbor, ME.

March 13, 2008. Groden, E. 2008. The European Fire Ant: A New Stinging Insect in the Northeast? Waltham Services, Inc. 2008 Technical Symposium, Waltham, MA.

April 2008. Groden, E. and F. Drummond. 2008. IPM of Pest Ants in the Urban/Suburban Landscape: NE-IPM Project. NEREC IPM Annual Meeting, Newport, RI.

August 2008. Levitsky, T., J. Lund, and E. Groden. Ecology and Management of the European fire ant. Eastport Community Center, Eastport, ME.

November 2008. Groden, E. The invasive European fire ant. Presented at the Friends of Edith Patch Annual Meeting, Page Museum, University of Maine, Orono, ME.

Other Presentations:

December 2007. Arevalo, H. A. and Eleanor Groden. 2007. Food preference of the European red fire ant, Myrmica rubra, throughout the field season in eastern Maine. Annual Meeting of the Entomological Society of America, San Diego, CA.

December 2007. Graham, C., E. Groden, H. A. Arevalo-Rodriquez, and F. Drummond. 2007. Evaluation of bait station strategies for management of the European fire ant (Myrmica rubra). Annual Meeting of the Entomological Society of America, San Diego, CA.

2008 Lund, J., E. Groden, H.A. Arevalo, and F. Drummond. Seasonal Variation of Nutrient Assimilation in European Fire Ant (Myrmica rubra) Colonies. Entomological Society of America Annual Meeting, Reno, NV

2008. Lund, J., C. Klass, E. Groden, S. Whitney King, H. A. Arevalo, and T. Levitsky. A Survey of Pestiferous Ants in Suburban Landscapes of Maine and New York. Entomological Society of America Annual Meeting, Reno, NV.

January 2009. Lund, J., E. Groden, H.A. Arevalo, and F. Drummond. Seasonal Variation of Nutrient Assimilation in European Fire Ant (Myrmica rubra) Colonies. Inter-agency Invasive Species Conference, Annapolis, MD.

February 2009. Bernard, K., E. Groden, and F. Drummond. 2009. Natural plant product repellents for the European Fire Ant. Eastern Branch Entomological Society of America. Harrisburg, PA.

H. Impacts

We have been very successful raising awareness of the differences between beneficial and pestiferous ants in the landscape. Since the term "pest" is very subjective for most of the ant species, we are providing our stakeholders information about ant behavior, benefits that ants provide in managed ecosystems and consequences of control actions necessary for clients to make informed decisions about controlling ants in the landscape. In the case of *M. rubra,* since it is an aggressive invasive pest, we are educating the public on specific-ant behavior, ecological effects of invasion, and control tactics. Among the management techniques recommended we make sure to include both cultural methods, and chemical methods. However, much of our emphasis is focused on prevention. We have however, demonstrated that a sucrose bait is an effective bait for delivery of toxins to all stages of *M. rubra* colonies and that a bait station strategy utilizing a sugar-based bait can significantly reduce *M. rubra* activity in infested areas. This strategy concentrates the pesticide in containers that the ants recruit to, reducing environmental exposure compared with broadcast baits.

I. Appendices

Flier with information on European fire ant was developed and is being handed to stakeholders that are having problems with this ants

http://www.umext.maine.edu/onlinepubs/htmpubs/2550.htm

Website we developed through University of Florida about *M. rubra* history, behavior, identification and management

http://creatures.ifas.ufl.edu/urban/ants/Myrmica_ruba.htm

Current Website for *M. rubra* – the new website will launch December 15, 2009

http://biology.umaine.edu/fireant/index.html

Newspaper article "Scientists study red ant problem on Mount Desert Island" from the Mount Desert Islander newspaper Sept 21, 2007

http://mdislander.com/site/index.php?option=com_content&task=view&id=3837&Itemid=39

Magazine article "Villains in Vacationland" from the U Maine Today magazine, March-April 2007

http://www.umainetoday.umaine.edu/issues/v7i2/villains.html