



Texas Imported Fire Ant Research and Management Project

Progress Report - June 2002

Ecological Approaches to Species-specific Suppression of Exotic Fire Ants in Texas

Principal investigator and contact information:

Lawrence E. Gilbert
Section of Integrative Biology
University of Texas
Austin, TX 78712-1064
Email: lgilbert@mail.utexas.edu

Other Personnel:

Richard Patrock, Assistant Research Scientist
Natasha Mehdiabadi, Research Assistant, Doc Candidate
Marcus Kronforst, Research Assistant, Doc Candidate

Funding Amount/2 Years: \$549,000

Sub-Project A: Bringing Additional *Pseudacteon* Phorid Fly species and Ecotypes into Laboratory Production and Screening Them for Use in Fire Ant Biocontrol

A-1. Prospecting for new candidate phorid ecotypes and species in South America and coordinated specificity testing and bringing promising new species into culture and mass production

A-2. Life history or life cycle constraints to introducing South American phorids in Texas and selective improvement of laboratory stocks for biocontrol introductions

A-3. Maintenance and improvement of *P. tricuspsis* production.

Summary of Work to be Done:

1. Prospecting for new candidate phorid species in South America, coordinated specificity testing, and bringing promising new species and ecotypes into mass culture.
2. Study of life history or life cycle constraints to introducing South American phorids in Texas for fire ant biological control.
3. Continued production of *P. tricuspsis* with emphasis on strains selected for Texas conditions.

Major Accomplishments to Date:

We have

1. helped expand a cooperating laboratory in Argentina with leveraged funding to increase its capacity to study new prospect species of *Pseudacteon*.
2. carried out several field trips to study and collect *Pseudacteon* phorids in Texas-like habitats on northern Argentina.

3. discovered a new species of *Pseudacteon* and have evaluated the characteristics of several poorly studied species.
4. maintained production of our main stocks of *P. tricuspis*, currently used in releases.
5. prepared several publications on this work.

Goals Achieved: We have maintained base production of Brazilian *P. tricuspis* at 5-6,000 flies/week while adding two new biotypes of this species from Argentina. New candidate species are identified for further study.

Relevance to the Texas Imported Fire Ant Research Ant Management Project:

Biological control of imported fire ants will constitute the ultimate in sustainable and economic solutions to this problem species. Given their demonstrated effects on host fire ants, phorid flies of the genus *Pseudacteon* are likely to be at least one key element of any future overall biocontrol success. Basic comparative research on these insects is fundamental to the successful rearing and establishment of South American species in North America.

=====

Subproject B: Introductions of South American Phorids to Texas: Improving Methods of Release, Monitoring Outcomes, and Assessing Impact of South American Phorids on Ant Community Interactions and Fire Ant Populations

- B-1. Field Introductions and Monitoring of *Pseudacteon* in Texas.
- B-2. Research aimed to improve methods for phorid introduction and detection at biocontrol release sites.

Summary of Work to be Done: Research goals organized under this umbrella project will generally stay on the lines of investigation already established in the previous two years. They involve laboratory and field experiments on how phorids influence *S. invicta*'s dominance and pest status. All are integrated with, and applied to, ongoing attempts to introduce phorids for biological control (**Subproject B-1**). Such an integrated approach is motivated by a limited supply of phorid flies, of suitable sites for release, and/or of manpower. Field experiments described will be focused on phorid release sites so as to detect and track the establishment of a naturalized breeding population. Studies will also continue to seek improved methods for field introductions and monitoring of phorids and their effects (**Subproject B-2**).

Major Accomplishments to Date:

- We have:
1. Begun releasing and monitoring of phorid flies at three (3) sites in addition to the fifteen (15) previous sites begun in 1998-2001 (A). We also renewed releases of flies at four sites; at two of these sites reproduction had been recorded previously but had apparently faltered due to drought.
 2. Begun base-line community assessments at two of the new sites (A).
 3. Flies reproduction was found at three of the four sites with recent re-releases. New releases at two of the sites are too recent to expect fly reproduction.
 4. Completed data collection and analysis of two field studies examining relationships between food 'burial', ant competition and phorid fly attacks.
 5. We completed and submitted for publication papers based on past work.

Goals Achieved:

1. Obtained further information for long-term establishment of phorids in the face of harsh environmental conditions.
2. Showed that 'protection of food' by burial does not appear to deter discovery by fire ants but may affect recruitment of workers. Burial was also found to reduce desiccation of baits. In transect work, food burial was not related to either presence of phorids or levels of competition with other ants but was strongly related to fire ant density.

Relevance to the Texas Imported Fire Ant Research Ant Management Project: Biological control of the imported fire ant is the best hope for low-cost and sustained suppression of this exotic species below economically and ecologically damaging thresholds. Phorid flies have great potential to be a major part of a biological solution to the fire ant problem. Understanding how best to introduce these parasitoids, how to monitor the success establishment, and how to assess their biological control potential in the field are fundamental elements of any biocontrol attempt. Greatly expanding the diversity and sites across Texas where phorids are introduced will greatly improve our probability of success.

=====

Subproject C : Genetic Analysis of *Pseudacteon* Phorid Flies Using Amplified Fragment Length Polymorphisms (AFLP)

Summary of Work to be Done:

- 1) Determine the degree of genetic variation present in cultivated stocks of *P. tricuspis* and that of wild-caught samples. By comparing these measures of genetic diversity we will be able to determine what impact the founding of cultivated stocks by a relatively small number of wild-caught individuals and subsequent inbreeding have had on the genetic make-up of our cultivated stocks.
- 2) Continue to sample and assess the genetic variation of cultivated stocks from this point forward. By sampling a small number of individuals from all cultivated stocks at regular intervals we will be able to monitor the impact of ongoing inbreeding and, if necessary, implement occasional outcrossing in order to maintain genetic diversity.
- 3) Compare the genetic structure of the cultivated *P. tricuspis* stock which has been artificially selected for small size to the unselected stock in order to determine what impact, if any, artificial selection for small size has had on the genetic variation present in this stock and whether these two stocks are genetically distinguishable despite occasional gene flow. If these stocks are distinguishable we will locate stock-specific genetic markers which will allow us to associate wild recaptured individuals with their founding stock.
- 4) Expand the study to additional *Pseudacteon* species as they are brought into cultivation.
- 5) Examine the genetic structure of native *Pseudacteon* on *S. geminata* and *S. xyloni* to get a perspective on the genetic diversity maintained in what are increasingly isolated and small populations in Texas.

Major Accomplishments to Date:

We have

1. extracted DNA from over 200 phorid flies of different species and different lab stock origins.

2. established that adequate genetic variation in AFLP markers is present in laboratory stocks of *P. tricuspis* to characterize evolutionary genetic changes through time and to distinguish sources of successful introductions in cases where different lines are used in the same region.
3. applied AFLP techniques to identifying male phorids caught during monitoring. These would otherwise not be distinguishable from males of native Texas *Pseudacteon*.

Goals Achieved: Our major goals for the AFLP study have not been achieved at this date, but our progress toward those goals is on schedule.

Relevance to the Texas Imported Fire Ant Research Ant Management Project: Accurate information on the relationship between the genetic composition of released phorids and of those which actually establish will provide valuable guidance for improving the efficiency of introduction attempts.

Products; publications submitted/published; presentations/posters presented at state and national technical conferences:

Products:

Flies Produced and Released

- Flies produced for experiments and release in Texas during Year One: over 200,000
- Flies used in biological control releases in Texas Sept. 1, 2001 to present: over 33,000

Release Sites Established: 18

Publications:

Gilbert, L.E. and R. Patrock 2002. Phorid flies for the biological suppression of imported fire ants in Texas: Region specific challenges, recent advances and future prospects. Southwestern Entomologist. In press.

Folgarait, P.J., O.A. Bruzzone, and L.E. Gilbert .2002. Development of *Pseudacteon cultellatus* (Diptera: Phoridae) on *Solenopsis invicta* and *Solenopsis richteri* fire ants (Hymenoptera: Formicidae). Environ. Entomol. 31:403-410.

Folgarait, P.J., P. D'Adamo, and L.E. Gilbert. In press. A grassland ant community in Argentina: the case of *Solenopsis richteri* and *Camponotus punctulatus* attaining high densities in their native ranges. Annals Entomological Society of America.

Folgarait, P.J., O.A. Bruzzone, and L.E. Gilbert. Seasonal patterns of activity among species of ant parasitoid flies in central Argentina explained by analysis of climatic variable (*Pseudacteon* spp.: Phoridae). Submitted to Environmental Entomol. Biological Control Section.

Folgarait, P.J., R.J.W. Patrock, Lawrence E. Gilbert, and Octavio A. Bruzzone. Studies of host ant acceptability and suitability for some Argentinean species of *Pseudacteon* (Diptera: Phoridae), parasitoids of worker fire ants, genus *Solenopsis* (Hymenoptera: Formicidae). Submitted to J. Econ. Entomol.

Mehdiabadi, N.J. and L.E. Gilbert. 2002. Colony-level impacts of parasitoid flies on fire ants. Proceedings of the Royal Society of London, Series B. In press.

Morrison, L., W. Long-term effects of the *S. invicta* invasion on native ant fauna at Brackenridge Field Laboratories, Austin, TX. Ecology In Press.

Wuellner, C.T and J.B. Saunders. Circadian and circannual patterns of activity and territory shifts: comparing a native ant (*Solenopsis geminata*, Hymenoptera: Formicidae) with its exotic, invasive congener (*S. invicta*) and its parasitoids (*Pseudacteon* spp., Diptera: Phoridae) at a central Texas site. Annals Ecol & Pop Bio. Accepted.

Wuellner, C.T. and C. Crusco. Phorid fly presence interferes with midden work in the fire ant, *Solenopsis invicta* (Hymenoptera: Formicidae). Submitted to J. Insect Behavior.

Presentations:

- Gilbert, L.E. 2002, Jan 10 Imported Fire Ants and Phorid Flies. Brigham Young Univ, Salt Lake City, UT
- Gilbert, L.E. 2002, Mar 21 Las moscas sudamericanas del genero *Pseudacteon* como candidatos potenciales de control biologico de las hormigas de fuego (*Solenopsis*), exoticas en los EE.UU.: un informe de progreso. V Congreso Argentino de Entomologia, Ciudad Autonoma de Buenos Aires.
- Gilbert, L.E. 2002, Apr 17 Imported Fire Ants and Phorid Flies. University of Puerto Rico.
- Mehdiabadi, N. 2001. Keynote Speaker at Howard Hughes Medical Institute Undergraduate Research Symposium, Texas Tech University.
- Mehdiabadi, N. 2001. Texas A&M University, Department of Entomology.
- Mehdiabadi, N. 2001. Texas Association of Biology Teachers, Conference for the Advancement of Science Teaching, Austin, TX.
- Patrock, R.J.W. 2002, May 15. Recent advances in imported fire ant biological control research in Texas. Thinking Adult Program, Austin, TX
- Patrock, R.J.W. 2002 Mar. 1. Burial of food by ants: ecological and phylogenetic considerations. Texas Academy of Sciences Annual Meeting, March 1, 2002. Laredo, TX.
<http://www.tpwd.state.tx.us/tas/abstracts.htm>
- Patrock, R.J.W. 2001 Dec. 20. Recent advances in imported fire ant biological control research in Texas. Centro de Estudios e Investigaciones , Universidad Nacional de Quilmes, Buenos, Aires, ARG.
- Patrock, R.J.W. 2001 Aug 12. Tools as weapons: interference competition by harvester and fire ants. University of Haifa, Oranim Israel.
- Smith, C. 2002 April 5-7 Differential Attraction of a Parasitoid to Dead Host Ants and More. Florida Evolution and Ecology Symposium, Archbold Biological Station, Lake Placid, Florida.

Funding Awards:

- Mehdiabadi, N. 2002. Dorothea Bennett Memorial Graduate Fellowship Fund and Professional Development Award for Travel, University of Texas.
- Mehdiabadi, N. 2002. Carl Gottfried Hartman Graduate Fellowship – Summer Merit Award, University of Texas.
- Mehdiabadi, N. 2001. Ari Yehiel Blattstein Endowed Presidential Scholarship, University of Texas.
- Mehdiabadi, N. 2001. Dorothea Bennett Memorial Graduate Fellowship Fund for Research, University of Texas.

Leveraged External Resources:

Approximately \$100,000 from three foundations during Year One, and purchase of vehicle by the University of Quilmes for our cooperator in Argentina