# THE RED IMPORTED FIRE ANT VERSUS HUMANS

by

Erica Estep

A Thesis Submitted to the Faculty of

The Wilkes Honors College

in Partial Fulfillment of the Requirements for the Degree of

Bachelor of Arts in Liberal Arts and Sciences

with a Concentration in Biology

Wilkes Honors College of

Florida Atlantic University

Jupiter, Florida

May 2013

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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. James K. Wetterer, and has been approved by the members of her supervisory committee. It was submitted to the faculty of The Honors College and was accepted in partial fulfillment of the requirements for the degree of Bachelor of Arts in Liberal Arts and Sciences.

SUPERVISORY COMMITTEE:

_____

Dr. James K. Wetterer

_____

Dr. Jon Moore

_____

Dean Jeffrey Buller, Wilkes Honors College

_____

Date

**Acknowledgments**

I would like to extend my gratitude to G. F. Estep, S. H. Estep, J. K. Wetterer and J. Moore for commenting on the manuscript and a special thanks to I. J. Apap for all his advice and assistance formatting.

ABSTRACT

Author: Erica Estep

Title: The red imported fire ant versus humans

Institution: Wilkes Honors College of Florida Atlantic University

Thesis Advisor: Dr. James K. Wetterer

Degree: Bachelor of Arts in Liberal Arts and Sciences

Concentration: Biology

Year: 2013

The red imported fire ant, *Solenopsis invicta*, originally from South America, has become a major pest in the southeastern US. Its painful stings can result in anaphylactic shock and even death. For my thesis research, I wished to examine how and where people are exposed to these stings and what could be done to minimize this exposure. I surveyed ants around and under picnic benches at four sites in Palm Beach and Martin Counties, Florida. I compared the incidence of *S. invicta* and other ants for picnic benches on artificial substrate (brick, concrete, gravel, or pavement) versus relatively natural substrate (grass or sand). I found that substrate had no significant effect on the occurrence of *S. invicta* and other ants; in all cases, incidence rates were very low. I found out, however, that ants were being controlled using chemical poisons at some sites. Future research should examine control methods for efficient elimination of *S. invicta* in areas where people are likely to be expose

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## Introduction

There is nothing quite like the first time you step into a fire ant colony. The swarming, stinging, burning sensation followed by the realization that your body is under attack leaves a lasting impression. There are many species that inhabit the Southeastern United States, but few species are as ubiquitous and have as nasty a reputation as the red imported fire ant, *Solenopsis invicta*. Its familiar mound, painful sting and distinctive, raised pustules are a nuisance to both humans and native animal species alike. Along with wildlife biologists, Floridians are aggravated by *S. invicta*. Arriving in the US in the 1930s, *S. invicta* came from the grasslands of Paraguay and Brazil (Allen *et al.* 1998, Fig. 1). It likely stowed away as part of a ship's cargo or as soil used for ballast.

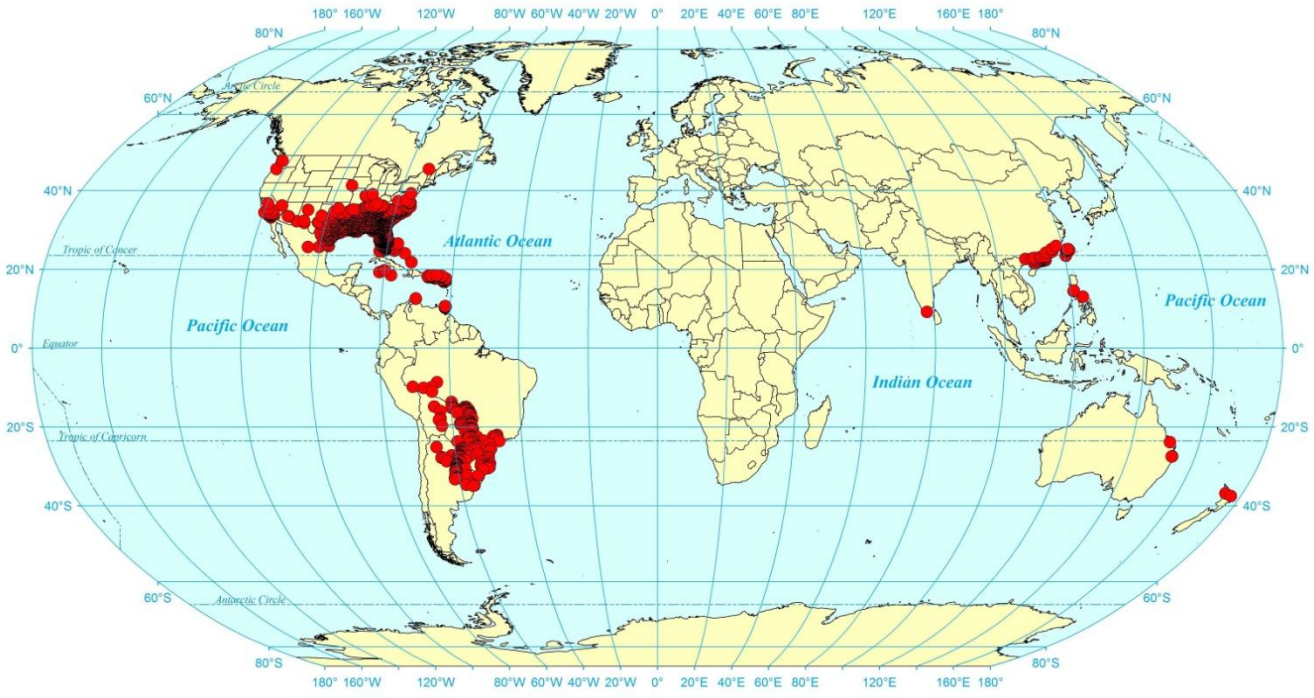


**Fig. 1.** Distribution of *S. invicta* worldwide (from Wetterer 2013).

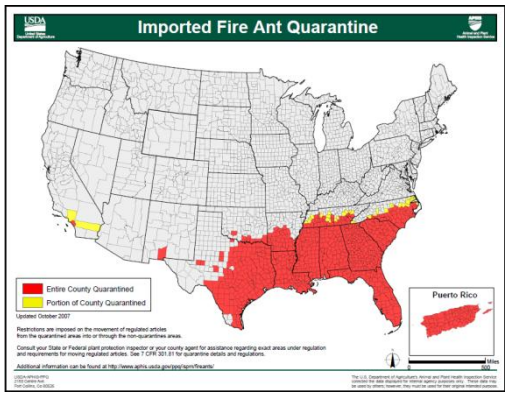


**Fig. 2.** Fire ant map in US (from Animal and Plant Health Inspection Service 2007).

In the US, *S. invicta* colonizes an area bounded by the states of Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, Texas as well as Puerto Rico and the Virgin Islands (Oi and Koehler 1994, Fig. 2). As their numbers increase, much of the West Coast may find itself soon invaded by these pests. In total, it is estimated that about one-third of the United States will eventually harbor *S. invicta*. Areas recently disturbed are most often the ones at which *S. invicta* establish nests (Tschinkel 1988). This colonization of disturbed areas is a shared attribute of many invasive species (Elton 1958). For my thesis research, I wished to examine how people are exposed to *S. invicta* attacks.

An incredibly aggressive species, *S. invicta* will attack intruders with little provocation. Their sting is particularly damaging due to its unique chemical composition. Whereas other stinging insects of order Hymenoptera have venom which is ~50% proteinaceous, fire ant venom consists chiefly of alkaloids (Greenberg 1988). These alkaloids trigger the release of histamines which causes a burning sensation and results in pustules. Fire ants have the ability to sting repeatedly and will carry on even when their limited volume of toxin has expired (Nattrass and Vanderwoude 2001). In extreme cases, *S. invicta* stings can result in anaphylactic shock and even death (Drees 2002).

Most studies of fire ant stings take place in medical clinics, but few studies have examined preventative measures. The abundance of *S. invicta* is concurrent with a decline

in indigenous and other alien ants as well as the increased urbanization of neighborhoods (Wojcik 1994). Arthropod communities and a good number of other species populations have been affected by *S. invicta*. More importantly to people, however, is the effect of their powerful venom on allergic patients who are predisposed to develop extremely debilitating or deadly symptoms, including anaphylactic shock.

An issue of concern is how and where people are exposed to these stings and what could be done to minimize this exposure. This study attempts to examine the effect of urban planning on fire ant infestation. To this end, I measured the presence of *S. invicta* around and below picnic benches. I believe that they are readily established in these areas because they provide a disturbed habitat and readily available food source (i.e. left behind lunches). I approximated the incidence of stings by assessing the number of ants beneath a given picnic table. I hypothesized that anthropogenic landscape transformations would lead to a decline in the presence of *S. invicta*.

**Materials and Methods**

I collected ants in Stuart, Florida, Hobe Sound, Florida, and Jupiter, Florida from October 2012 to February 2013 (four sites: Mary Brogan Park, two picnic areas raised on concrete slabs, 27.14N, -80.23W, 28 October 2012; Hosford Park, two areas raised on concrete slabs, 27.11N, -80.25W, 28 October 2012; Jonathan Dickinson, concrete, grass/sand, gravel and pavement areas, 26.99N, -80.15W, 11 and 12 November 2012; the MacArthur campus of Florida Atlantic, brick, concrete, grass/sand, and gravel areas, 26.89N, -80.12W, 19 November 2012, 5 February 2013, 7 February 2013, 12 February

2013). After collecting ants at all four sites I chose to concentrate my efforts in February on a comprehensive sampling of the FAU campus.

I evaluated evidence for the presence of fire ants as a fire ant or fire ant colony present inside an area of 3 m radius from a bench. The presence of fire ants was determined by brushing and prodding the exterior of the colony. Presence of fire ants was recorded as either present or absent at each area. I evaluated whether each location seemed to have an effect, as abandoned colonies could indicate chemical control. I surveyed fire ants by placing a folded index card containing 1 gram of tuna under each table in the picnic area. After 30 min, a time period I estimated to replicate the average picnic, I returned and put each card in a zip-locked bag. Afterward, I placed the collected specimens in a freezer, counted the number of ants in each bag and put them in vials of 95% ethanol for later identification. At FAU, I began documenting ant colonies and picnic tables by obtaining photographs and making notes on conditions.

The design of this experiment measures two variables, ants (absence versus presence) and substrate (brick/concrete/gravel/pavement versus grass/sand). Cell counts for the chi-square test have to be five or more in at least 80%. I categorized man-made substrates together, because the goal of the project is to ascertain whether humans may control the abundance of ants by altering the location of the picnic benches. Hence, our decision to group man-made surfaces together is not an arbitrary one but an effort to analyze if these efforts affect the abundance of ants. Fire ant distribution at observed locations was compared to a random distribution. Numbers of areas with *S. invicta* present per category were then compared using chi-squared tests. An alpha of 0.05 was used for determining significance for all tests.

**Results**

I surveyed a total of 55 picnic table areas. Ants, including *S. invicta*, were present at 38% of all picnic area baits, and 7% of picnic areas were populated solely by *S. invicta*. Working with James Wetterer at FAU, I identified and counted the ants according to species from each of the 18 baits collected in October-November and the 37 baits collected in February. Distribution of ants was not significantly different from a random distribution (Table 1). Grass and sand areas did not demonstrate significantly higher ant ($X^2$=0.2191, 1 df, P>0.5) or *S. invicta* population ($X^2$=0.3176, 1 df, P>0.5) (Table 2).

*Brachymyrmex* nr *obscurior* was the most common group found in 2013 and *S. invicta* in 2012 (Table 3). According to Deyrup *et al.* (2000), *Brachymyrmex* ants are a challenge for categorization. Ants are classified as *Brachymyrmex* nr *obscurior* when they are dark and large. Apart from *S. invicta*, a comparable fraction of areas had ants in both groups in 2012 (Fig. 3). In 2013, the average number of ants was higher at anthropogenic areas (Table 4). In 2012, *S. invicta* were lured to the baits in higher numbers than other ant species (Table 5).

**Table 1. 2 x 2 contingency table relating ant presence and area category.**

| | Ants | No ants | Total |
|---|---|---|---|
| Grass/sand | 14 | 20 | 34 |
| Not grass/sand | 10 | 11 | 21 |
| Total | 24 | 31 | 55 |

**Table 2. 2 x 2 contingency table relating presence of *S. invicta* and area category.**

| | *S. invicta* | No *S. invicta* | Total |
|---|---|---|---|
| Grass/sand | 3 | 31 | 34 |
| Not grass/sand | 1 | 20 | 21 |
| Total | 4 | 51 | 55 |

**Table 3. Ants collected at tuna baits at areas in 2012 (n=18) and 2013 (n=37).**

| | No. benches | |
|---|---|---|
| | 2012 | 2013 |
| *Solenopsis invicta*[a,b] | 4 | 0 |
| *Dorymyrmex bureni* | 3 | 0 |
| *Tapinoma melanocephalum*[a] | 1 | 3 |
| *Brachymyrmex* nr *obscurior*[a] | 0 | 5 |
| *Pheidole* sp.[a] | 0 | 3 |
| *Tetramorium simillimum*[a] | 0 | 2 |
| *Technomyrmex difficilis*[a] | 0 | 1 |

[a] Not native to Florida (Deyrup *et al.* 2000, James Wetterer 2013, pers. comm.).

[b] Threat to humans.

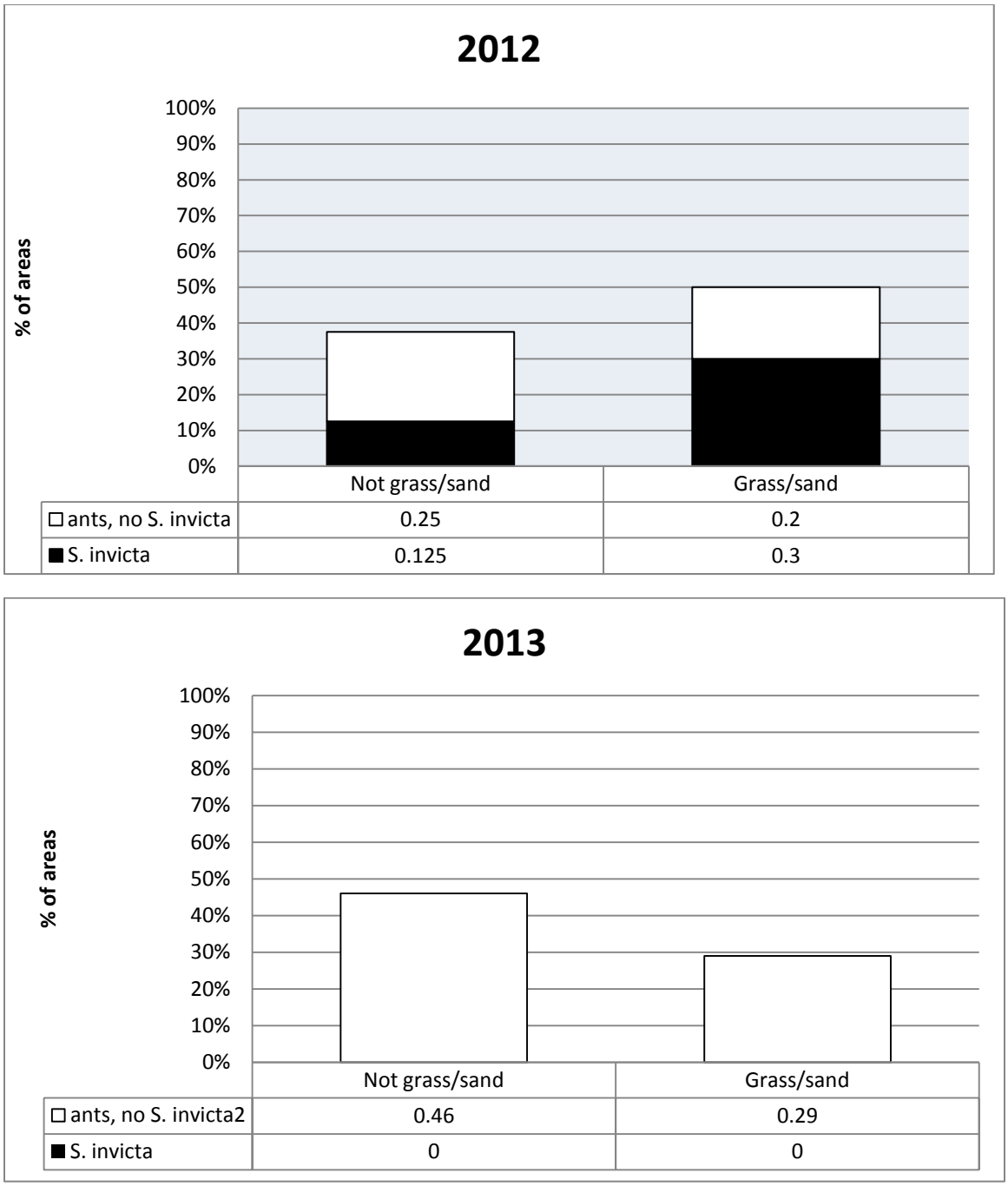


**Fig. 3.** Occurrence of ants at areas in 2012 and 2013.

**Table 4. Average number of ants present in relation to material at baits with ants, but no *S. invicta* present and at baits with *S. invicta* present (number of areas in parentheses)**

| | 2012 | | 2013 | |
|---|---|---|---|---|
| Material | No *S. invicta* | *S. invicta* | No *S. invicta* | *S. invicta* |
| Grass/sand | 8 (2) | 8 (3) | 1 (7) | 0 (0) |
| Not grass/sand | 2 (2) | 10 (1) | 2 (6) | 0 (0) |
| Overall | 5 (4) | 9 (4) | 2 (13) | 0 (0) |

**Table 5. Average number of ants present at all areas in relation to material (number of areas in parentheses)**

| | 2012 | | 2013 | |
|---|---|---|---|---|
| Material | No *S. invicta* | *S. invicta* | No S. invicta | *S. invicta* |
| Grass/sand | 2 (7) | 8 (3) | 0 (24) | 0 (0) |
| Not grass/sand | 0 (7) | 10 (1) | 1 (13) | 0 (0) |
| Overall | 1 (14) | 9 (4) | 1 (37) | 0 (0) |

**Discussion**

Based on my findings, my hypothesis that *S. invicta* populations would differ depending on picnic table substrate was not supported. My hypothesis, however, did not take into account other efforts used to control ants in picnic areas. A further study would either need to be carried out at areas at which ants are known not to be controlled or else to apply fire ant granules, for example, only to one area category. A more effective approach could be in chemical control as opposed to physical deterrents. Two hypotheses needing further investigation are: 1) granules are a better treatment for *S. invicta*, compared with Amdro; and, 2) ant piles can be moved a few feet away from areas of high human activity in order to decrease the likelihood of stings.

The absence of *S. invicta* from samples collected in 2013 might be accounted for by confounding variables. First, JDSP was the location at which the majority of surveys were carried out in 2012. All samples in 2013 were taken at picnic areas on the campus of FAU. Secondly, cold or rainy weather in February can suppress foraging, explaining the differences. Thirdly, 30 min. could be too short an interval for forager ants to discover the bait. If I had allowed *S. invicta* 2 h, instead of 30 min, to find the bait, then it is possible that my number of individuals would have been higher (Wetterer *et al.* 2007). Fourthly, classifying impervious materials (pavement/concrete) and materials the ants may burrow

through (brick/gravel) might have overlooked differences between these manmade materials at least in how close the ant colony may be to the table. Combining these anthropogenic substrates does not indicate if one type is better than the rest. Finally, after the preliminary survey at FAU in 2012, the application of fire ant granules could have destroyed colonies of *S. invicta*.

Ant species at JDSP in regions highly populated by visitors were treated by a chemical insecticide called Amdro, an attractant composed of hydramethylnon. It contains gradual acting toxicants dissolved in soybean oil (Oi and Koehler 1994), and is used anywhere at JDSP where there is regular visitor traffic, including picnic areas and the campgrounds (Scott Tedford 2013, pers. comm.). In terms of ant population control, hydramethylnon is considered an appropriate insecticide as it operates in hot circumstances and degrades within days (Vander Meer *et al.* 1982). An insect-specific inhibitor, this bait has a half-life of 41.9 minutes in daylight (Mallipudi *et al.* 1986). It has been employed before a festival or event, after a camper complaint or if a large nest is discovered in a common area, for at least six years.

Individual mound treatment methods include insecticides that are formulated as baits, drenches, dusts, aerosols and granules (Oi and Koehler 1994). Bait goods used for broadcast bait applications are able to be applied to individual piles. Drenches are solutions consisting of insecticides and water that are applied to colonies. Dusts are insecticidal products that are dehydrated powders. A few products are accessible in aerosol cans equipped with a probe and are full of insecticides that abruptly bring ants to a halt and eradicate ants on contact. As a general rule, granules are composed of insecticide that is carried into the colony after the granules are wetted with water that is

poured over the granules. As with the drenches, granules are effective only if the insecticide penetrates the colony and comes in contact with most ants and the queen.

At FAU, this process forces colonies to move 1-1.8 m from the site of treatment (Tom Owen 2013, pers. comm.). Granules are utilized on Thursday, once per week. Typically, students report colonies to a professor, and he contacts the maintenance crew. Maintenance crews also treat colonies if they notice them walking from point A to point B. Additionally, although Orkin pest control management tries to get to picnic areas, if somebody does notice a colony of ants and calls them, they will make it a priority.

Future research should examine control methods for efficient elimination of *S. invicta*. Areas in which ants are present should be treated and ant numbers compared before and after treatment. A control group should be established that does not receive treatment. Ants and humans can both exist in the same area as long as the two do not come in contact frequently. As fire ants are forced to relocate their colonies, humans will be free from the age old annoyance of ants at a picnic.

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