

## INTRODUCTION

This survey targets the little fire ant, *Wasmannia auropunctata*, on the island of Maui. The reason for this survey is put into good perspective by excerpts from a brochure prepared for release on the Big Island of Hawaii in 2006 (CTAHR 2006):

Little fire ants (LFA) are stinging ants that are new to Hawaii, and spreading. They are transported to new sites in potted plants and on other plant materials or rubbish.

These tiny ants tend to get under your clothes and can get in your eyes. Initially their sting hurts and burns strongly. It usually causes intense itching that can last for two weeks or more. LFA stings are also known to harm animals, including pets and livestock; multiple stings in the eyes can cause blindness in pets or even the death of newly born small animals.

The ants climb up into plants of all sizes, including trees. They drop off easily when the plants are disturbed, and they can rain down on you in large numbers when you are pruning branches, harvesting fruit, or picking flowers. Some orchard workers in East Hawaii have quit their jobs because of this. In the Galapagos Islands, when LFA populations are large, workers are prevented from harvesting coffee.

A heavy infestation can make a property difficult to use commercially or enjoy recreationally. Casual dress is best avoided where LFA have taken hold—gloves, boots, and full body covering are needed in severely infested areas, where any contact with foliage, including sitting on lawns, can invite a sting. An LFA infestation is a “disclosure issue” in property sales.

The little fire ant is native to Central and South America, but it has spread around the Pacific. It was first noticed in Hawaii in 1999 at Hawaiian Paradise Park in Puna. Although the Hawaii Department of Agriculture worked to contain the initial infestations, the ant had already been spread, inadvertently, from infested plant nurseries.

Currently there are about 50 known LFA infestations in East Hawaii, one on Kauai, and probably many more on Hawaii that have yet to be discovered and reported. The Kauai LFA population appears to have been [nearly] eradicated, but monitoring continues. On Hawaii, limited agency resources and personnel, the few registered pesticide options, and continuing spread of the ants on infested plant material make it virtually impossible to have a wide-scale government program sufficient to eradicate this pest. People who own or live on the lands that LFA have infested must be willing to put serious, sustained effort into controlling them.

LFA has not yet been found on Hawaiian islands other than Hawaii and Kauai. However, inter-island trade of potted plants and other materials presents the opportunity for LFA to be transported from one island to another. The primary objective of this study was to locate small populations of LFA on Maui that could potentially be removed before becoming well established. A secondary objective, as it was likely that no LFA would be detected on Maui based on work done in previous surveys, was to create distribution maps for all ant species collected during the study. The survey used peanut butter baited chopsticks to attract ants, which were then collected and identified. This survey differed from previous surveys by looking at a broad range of locations, with a main emphasis on new developments. In the end, no LFA were found on Maui, but 20+ species of ants were detected and mapped.

### **SPREAD, BIOLOGY, AND IMPACTS OF LFA ELSEWHERE**

In recent years, the LFA has emerged as a major exotic pest that “could easily be in the early phases of a pantropical explosion” (Deyrup 1991, cited by Wetterer and Porter 2003). Through human commerce and trade, this tiny (ca. 1.5mm in length) stinging ant has spread throughout tropical regions of the world including West Africa, islands of the Caribbean, Florida, and islands of the Pacific, including Galápagos, New Caledonia, Solomon Islands, Vanuatu, Tahiti, and Hawaii (Wetterer 2006). An extra-tropical invasion occurred in the Jordan Valley of Israel (north to 32° 43' N) several years ago, presumably on imported logs from Gabon in West Africa (Vonshak *et al.* 2006, unpublished). Previously the northernmost site of LFA establishment was considered to be a location in Bermuda at 32° 20' N (Wetterer and Porter 2003). The area invaded in Florida is south of 30° N.

Invasive ant species have certain characteristics that make them more likely to invade new areas and more likely to succeed once they arrive. LFA have generalist feeding habits, superficial nests, high colony mobility, multiple queens in a colony, colony budding, low intraspecific aggression, high aggression toward other species, and tend to feed on nectaries of plants and insects in the order Homoptera (Brandao and Paiva 1994, Passera 1994). They are able to establish and nest in a variety of conditions, from wet to dry habitat in open or shaded areas, under rocks, in or under logs, in plant debris, or in trees (Deyrup *et al.* 2000). They have a remarkable, recently discovered, ability to react adaptively for dispersal when their many-queened colonies are disturbed - they are behaviorally programmed to reorganize in units of a single queen with 5-6 workers on her back - potentially providing the means of establishing a new colony (Feitosa 2007).

LFA pose a major nuisance to humans and other vertebrates, both domestic and native, because of their powerful sting and aggressive nature. LFA often sting humans in homes and agricultural settings, with reports from virtually throughout the range of the ant (Wetterer and Porter 2003). In native range in Brazil, LFA were one of the most commonly found ant species in cacao plantations, forestry plantations, hospitals, and in homes (Buono and Fowler 1994, Delabie *et al.* 1995, Wetterer and Porter 2003). In Guadalcanal, Solomon Islands, local residents reported that their dogs were all gradually

blinded by the LFA's venom and rarely lived more than five years; chickens were also blinded (Wetterer 1997). In Gabon, in areas of high LFA density, domestic cats, leopards, elephants, and river hogs show evidence of corneal clouding and blindness, apparently from stings of LFA (Wetterer *et al.* 1999; Walsh *et al.* 2004). There is also evidence of young turtles and birds being negatively affected by LFA in Galápagos (Roque-Albelo and Causton 1999).

Silberglied (1972) found that LFA's "impact upon the Galapagos terrestrial invertebrate fauna appears to be the most serious of any introduced animal," a conclusion confirmed by many subsequent studies. Clark *et al.* (1982) found that *W. auropunctata* "either exterminates or reduces to very low density all sympatric species" of ants. Lubin (1984) found that areas with *W. auropunctata* present had not only lower diversity and density of other ants, but also lower densities of other insects, as well as scorpions and spiders, though honeydew-producing Homoptera increased. Negative effects of LFA on over 30 native ant species in New Caledonia are dramatic (Le Breton *et al.* 2005). In ant-rich (79 native ant spp.) forest and savannah of Lopé National Park, Gabon, in continental Africa, LFA were shown to sharply reduce (by 20x in areas invaded 10 years earlier) numbers of native ant species present (Walker 2006).

## **ANTS IN HAWAII AND THE THREAT OF ADDITIONAL INTRODUCTIONS**

About 51 species of ants have established in Hawaii, although a few of these have not been collected in many decades and possibly no longer occur (see Appendix 1 in Krushelnycky *et al.* 2005b; Neil Reimer pers. comm.). Hawaii's 51 species surpasses the known number of ant species introduced to nearly every other biogeographic region of the world (McGlynn 1999). Prior to human contact, Hawaii had no ant species (Wilson and Taylor 1967); all current species have arrived with human assistance, with six continents as well as oceanic islands represented among the sources of the modern Hawaiian ant fauna (McGlynn 1999, Krushelnycky *et al.* 2005b).

Reimer *et al.* (1990) have provided a comprehensive review of ants as pests in Hawaii, and Reimer (1994) and Krushelnycky *et al.* (2005b) review ant threats to native biodiversity. The most dominant and damaging species to date in Hawaii are believed to be the big-headed ant (*Pheidole megacephala*), the Argentine ant (*Linepithema humile*), the long-legged or crazy ant (*Anoplolepis gracilipes*), and the tropical fire ant (*Solenopsis geminata*). These four are among the six most disruptive ant invaders in the world, along with the red imported fire ant or RIFA (*Solenopsis invicta*) and LFA (*Wasmannia auropunctata*) (Holway *et al.* 2002). Hawaii already has five of the six and is immensely concerned about potential establishment of *S. invicta*, which reached California from the southern U.S. in 1998 and now occupies much of the southwestern Pacific Rim (Krushelnycky *et al.* 2005b). RIFA and LFA are the most feared potential ant introductions for the island of Maui and other Hawaii islands.

## **Island of Hawaii**

LFA had been previously intercepted but not established in the Hawaiian Islands as early as 1930 (Swezey 1945). LFA was first found and reported in March 1999 in the Puna District on the island of Hawaii, but evidence suggests that it had been present in the area for at least four years before its discovery (Conant and Hirayama 2000). Before the end of 1999, three additional populations were discovered, one 20 acres in area (Conant *et al.* 2007). It was found that LFA were being dispersed by movement of infested plants. By 2002, there were 20 known infestations, and by 2004, there were 31 populations covering over 76 hectares (188 acres) (Krushelnycky *et al.* 2005b). As of February 2007, the invasion has occupied 50 sites and has occurred as high as 1500 ft elevation (Conant *et al.* 2007). Many of these infestation sites include nurseries, farms, and orchards. Nursery shipments leaving Hilo for other islands have been checked prior to shipment by baiting for LFA by inspectors of the Hawaii Department of Agriculture for several years, but to date there are no measures other than attempts at comprehensive public education for preventing within-island spread on Hawaii.

## **Island of Kauai**

Months after LFA was discovered on the island of Hawaii in early 1999, a container of plants was shipped from an infested nursery to the island of Kauai (Null and Gunderson 2006). Suspecting that LFA could have been transported, HDOA personnel conducted a survey of the receiving property, located near Kilauea, Kauai, and confirmed their suspicions as LFA was found to be present (Null and Gunderson 2006).

An eradication project was initiated at the site and was thought to be successful as of 2000 (Null and Gunderson 2006). However, during monitoring in 2003 by the Kauai Invasive Species Committee (KISC), LFA was again found to be present and the area of infestation had spread to an adjacent property (Null and Gunderson 2006). Eradication efforts were resumed in 2004. To date, the site is monitored and treated twice yearly. It is believed that while eradication has not yet been achieved (probably because of colony survival in trees) the infestation is contained and has not yet spread to other areas.

From 2004-2006 an island wide survey was conducted on Kauai targeting nurseries, resorts, golf courses, and other areas known to have received shipments from infested areas of the island of Hawaii. To date, LFA has not been encountered at any other site on Kauai, other than the original site (Null and Gunderson 2006).

## **Island of Maui**

To date, no LFA have been found to be established on the island of Maui. However, it is known that shipments from infested areas on the Big Island are being sent to Maui. For example, there was an item in the October 4, 2006, HDOA E-news as follows: "August 31 - Hilo inspectors used peanut butter bait sticks to detect little fire ants in two pallets containing 2,000 mondo grass plugs. The shipment, destined for Maui, was rejected."

Because of the very significant potential for LFA invasion, surveys have been conducted on Maui to try to find small populations before they become widely established.

Previous LFA surveys on Maui (Figure 1) include work done by the Hawaii Department of Agriculture (HDOA), the U.S. Geological Survey (USGS), and the Maui Invasive Species Committee (MISC). None of these surveys have yet detected LFA on Maui.

Since 2001, HDOA has conducted annual surveys for LFA at Kahului Airport, Kahului Harbor, and other high risk sites. Additionally, certified nurseries are tested for LFA during the certification process.

In 2003, we (USGS) conducted a brief survey for LFA using methodology outlined by Conant and VanGelder (2003). Surveys focused on non-certified nurseries and locations with mature fish-tail palm (*Caryota* spp.) plantings.

In 2005, Maui Invasive Species Committee conducted a survey for LFA, by having students collect ants using methods outlined in the "Hoike o Haleakala" science curriculum, a multi-disciplinary, science-based environmental education curriculum designed to help sustain the native Hawaiian landscape and culture by helping students establish and deepen connections to the land and the culture it supports (HEAR 2003).

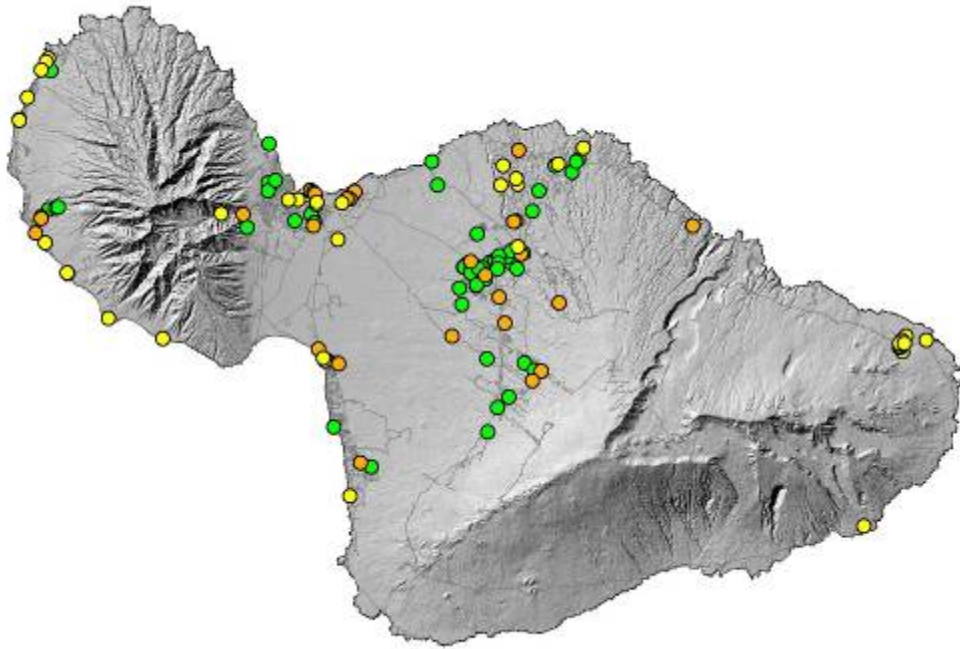


Figure 1. Map of 97 collection sites for previous Maui *Wasmannia* surveys. Includes work by USGS (yellow - 2003 survey), HDOA (orange - certified nurseries and ports), and MISC (green - Hoike program).

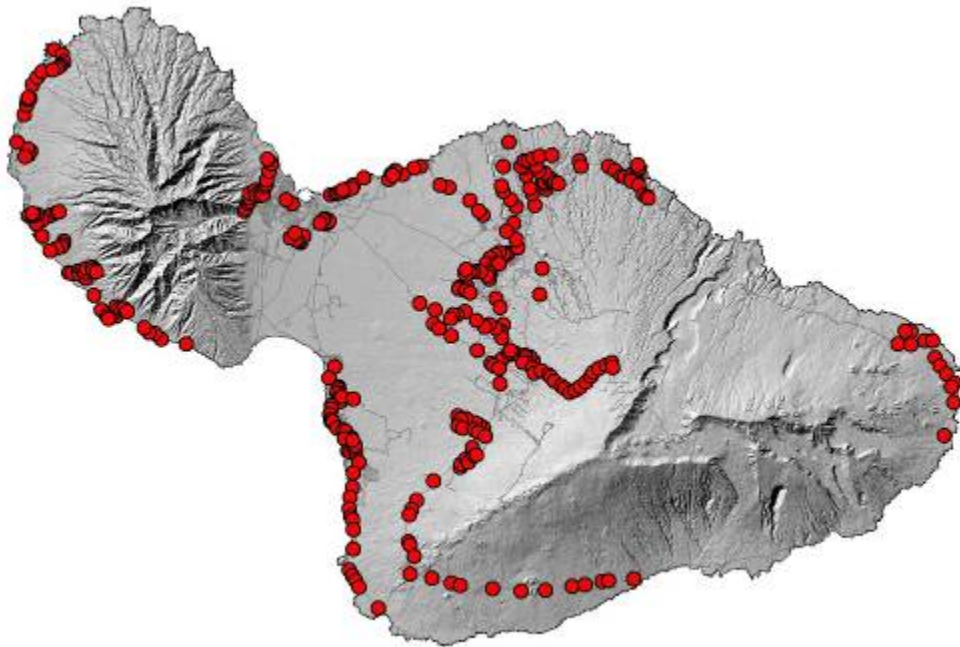


Figure 2. Map of 360 collection sites for current Maui *Wasmannia* survey.