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Huge Benefits From Managing Little Fire Ant on the Big Island

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The little fire ant (LFA), *Wasmannia auropunctata*, threatens native biodiversity, alters tropical ecosystems, impairs human health, impedes tourism, diminishes agricultural productivity, mars horticulture sales, and accordingly ranks among the world's worst invasive species. LFA will sting endangered reptiles and birds, interfering with reproduction, nesting, and survival of young. LFA will sting cats and dogs in the eyes repeatedly, eventually blinding them. They will crawl under clothing to sting people as well, causing pain, anxiety, and a long-lasting itchy rash. Unlike other invasive ants, which nest only on the ground, LFA will nest in trees and bushes and drop onto people who happen to brush by.

Little fire ant workers. Photo courtesy of Eli Sarnat (2008).

Little fire ants are native to Central and South America. They show a preference for warm, moist, and shady environments but require only tiny niches to survive and can establish colonies within leaf litter, beneath a stone, under tree bark, in an old log, within a compost heap, or high up in a tree. Colonies can be as small as one queen and a few workers. Human habitats and behaviors provide LFA with an abundance of food, habitat, and transportation, allowing the ants to move quickly, disperse widely, grow to high densities[1], and inhabit locations not otherwise available to them.

Little Fire Ants in Hawai‘i

Little fire ants (LFA) were first detected on the Big Island of Hawai‘i in 1999 but are thought to have arrived at least six years earlier. The Hawai‘i Department of Agriculture (HDOA) responded quickly and undertook a strategy to contain the infestation. Containment efforts likely slowed the rate of spread. However, within three years LFA were found in 21 locations, and within 5 years they were found in 31 locations.[2] Current infestations are along the eastern coast from Kalapana to Laupahoehoe up to an elevation of 2,000 feet; scattered populations have also been found in Kailua-Kona, South Kona, and Kā‘ū.[3] We estimated LFA to be currently established in at least 4,000 locations on the Big Island and spreading.[4] On Kaua‘i, an infestation discovered in 2000 was treated but not successfully eradicated. The single known infestation site has been monitored and is currently targeted for eradication. On Maui, an infestation was found in 2009; it was treated and monitored, and finally declared eradicated in 2013. Also on Maui, a longtime resident detected LFA on hapu‘u (tree-fern) logs purchased at a local garden shop and reported it to HDOA in December 2013. HDOA follow-up found multiple garden shops and O‘ahu and Maui selling potentially infested hapu‘u logs. At least 10–15 LFA-infested sites have been subsequently detected on O‘ahu.

Invasiveness

Little fire ants possess several traits allowing them to survive and establish in new locations. LFA can disperse and travel easily to new locations, hitchhiking with humans in commodities and cargo. Once in a new location, using multiple queens and multiple nests, LFA are able to readily establish colonies in natural and human-modified environments, needing only warmth, moisture, and shade. LFA will protect and "farm" aphids and scale insects that secrete a substance called honeydew that provides a major food source for LFA workers. LFA colonies will share food, queens, workers, and brood and will work together to defend their combined territories (i.e., foraging area) against competitors and disruptions. In ideal habitats where there is abundant food and few competitors, LFA can multiply to reach high population densities. Hawai‘i researchers found LFA populations of 20,000 ants per square meter, with an estimated 36 to 77 queens, in orchard situations.

Impacts

In agriculture, LFA infestations impair production. Crop yields decrease, pest control costs increase, and businesses are subjected to quarantines and bans on sales. Agricultural laborers often quit their jobs rather than be subjected to stings on a daily basis.

In the nursery industry, businesses are at high risk of infestation and re-infestation so must monitor incoming shipments for LFA. Infested nurseries must treat all products, cut flowers, potted plants, tools, and equipment to destroy LFA and avoid accidentally spreading LFA to new locations.

At residences, people will be stung working in their yards, cooking in their kitchens, reaching into cupboards, and sleeping in bed. In public parks, people are stung while hiking on trails, lying on the ground, or sitting at picnic benches. Children and teachers are stung at school while outdoors, in the playground, and in the classroom.

Control Options

Current treatment methods are effective at reducing the size of an infestation, mitigating damages, and preventing spread. A multi-pronged strategy may combine use of broad-spectrum contact pesticides, toxic baits, and treatment of infested commodities by irradiation or heat.[5] Prescribed biological controls against LFA do not currently exist.

Contact sprays such as carbaryl are used to drench potted plants. Residual sprays containing synthetic pyrethroids are most commonly used to create chemical barriers on the ground and around buildings.

Baited pesticides are placed within the LFA foraging area. Worker ants take the bait back to the nest to feed and kill the entire colony and queens. Baits are designed to exploit the natural behaviors of ants and are a primary strategy in the control of LFA. Compared with contact sprays, baits use less toxicant and have a very low non-target species impact.

Non-chemical options that lower LFA populations include reducing available nesting habitats by clearing vegetation and removing leaf litter. Replacing tropical foliage with drought-tolerant plants around homes and in landscapes, known as "xeriscaping," is an option that creates an expanse of dry microclimates that are not well tolerated by LFA.

Method

Our study[5] examined the future damages from LFA on the Big Island and estimated the potential benefits in terms of reduced damages from more aggressive LFA management. We developed a bioeconomic[6] model to forecast LFA spread and estimate economic and social impacts. We identified efficient strategies for managing LFA and mitigating damages. We specified seven economic sectors: nursery and floriculture, lodging, residential, agriculture, parks, schools, and all other in order to characterize impacts, model transport mechanisms, and allow for disaggregate management decisions. We employed simulation and optimization methodologies to assess benefits from increasing the effort against LFA.

Current management in the model is characterized as a comprehensive management approach that includes ant identification, response to new infestations, public information and assistance for treating LFA, technology development, and public awareness and education. In the residential sector, LFA infestations remain untreated until they become noticeably problematic, at which point treatment efforts and expenditures are proportionate to the level of infestation. In the business sectors, treatment efforts suppress damages within the sector and efforts are made to prevent human transport outside the sector, but natural spread to adjacent properties is not explicitly prevented. In the park and school sectors, LFA infestations remain undertreated due to insufficient funds, lack of authority of particular agencies, and limitations on where and how pesticides can be used.

Impacts under current management include economic losses, expenditures (for mitigation treatment[7] and management activities) and social damages (number of human and pet sting incidents). Impacts are quantified for each of the seven sectors annually for 10 years into the future. Economic losses and expenditures are sector dependent and vary with the size and extent of the infestation. Sting incidents[8] are sector dependent and based on the extent of the infestation, resident population, pet population, and employment in each sector.

Results

Our analysis indicates that under current management, LFA will continue to spread. Over the next 10 years, individuals and businesses on the Big Island will suffer $140 million in economic damages, spend $1.225 billion on mitigation treatment, and be subjected to 390 million human sting incidents and 107 million pet sting incidents. A reduction in management effort would entail greater damages and more frequent sting incidents. Attempting to eradicate all LFA colonies would significantly reduce damages and sting incidents but would be far too costly for the Hawai‘i Island economy.

Increased management effort is economically warranted. For example, early aggressive treatment to include extensive monitoring, containment, isolation, and LFA removal at a cost of $8 million over the next 3 years would result in a significant decline in LFA populations and a corresponding reduction in overall damages, treatment costs, and sting incidents. With more aggressive management over the next 10 years, individuals and businesses on the Big Island will suffer $11 in economic damages, spend $15 million on mitigation treatment, and be subjected to 76 million human sting incidents and 5 million pet sting incidents. The net savings from early aggressive treatment is $129 million in lowered economic damages, $1.21 billion in reduced control costs, 315 million fewer human sting incidents, and 102 million fewer pet sting incidents. Illustrated comparisons of current management and aggressive control appear in Figures 1 and 2.

These values represent only a portion of the benefits society would gain from increased LFA management.

Figure 1
Predicted costs over 10 years with current and increased management

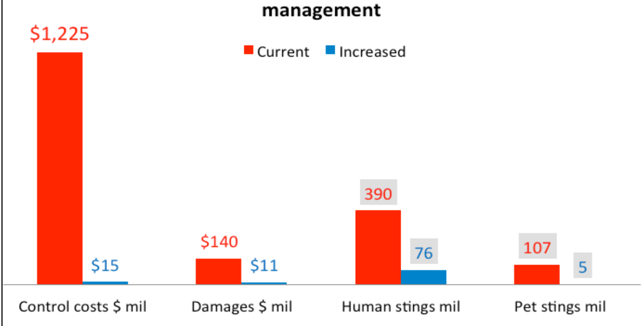

Figure 2
Predicted savings over 10 years with increased management

Economic benefits include reduced risk of spread to the other Hawaiian islands. Ecosystem benefits include reduced damages to nesting ground birds and wild honeybee hives. Full results from the model can be found in our technical report online.[4]

Conclusion

Additional funding of up to $15 million over the next 10 years focused on a coordinated effort comprising LFA prevention, monitoring, and control is economically warranted. Spread prevention, reduced LFA populations, and lowered LFA densities will yield huge cost savings to businesses, farmers, and local residents and result in millions of fewer sting incidents to residents, workers, tourists, and pets.

Endnotes

1. Krushelnycky, P.D., Loope, L.L., & Reimer, N.J. (2005). The ecology, policy, and management of ants in Hawaii. *Proceedings of the Hawaiian Entomological Society* 37, 1–25. Retrieved from http://hdl.handle.net/10125/103

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5. Hara et al. (2011). Bait insecticides and hot water drenches against the little fire ant, *Wasmannia auropunctata* (Hymenoptera: Formicidae), infesting containerized nursery plants. *Florida Entomologist* 94(3), 517–526.

6. A bioeconomic model is a dynamic mathematical representation of a living system that includes biological elements (survival and reproduction of LFA) with socioeconomic elements (LFA economic damages, management costs, and stings). Behavioral specifications (decisions about to prevent LFA from spreading and how much to spend on treatment) are used to link the elements and to evaluate different scenarios and outcomes.

7. Expenditures include LFA prevention and control measures to mitigate private damages in homes, lodging, on farms, in nurseries, at schools and in public parks.

8. We define a sting "incident" as a point in place and time during the course of a day when a person or pet will be stung. A single "incident" will typically involves multiple stings, which can vary greatly.

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