HB 481, HD1

TESTIMONY OF SCOTT E. ENRIGHT
CHAIRPERSON, BOARD OF AGRICULTURE

BEFORE THE SENATE COMMITTEE ON AGRICULTURE & ENVIRONMENT

MARCH 13 2017
1:15 P.M.
CONFERENCE ROOM 224

HOUSE BILL NO. 481 HD1
RELATING TO INVASIVE SPECIES

Chairperson Gabbard and Members of the Committee:

Thank you for the opportunity to testify on House Bill No. 481 HD1. This bill mandates the Department of Agriculture to establish a little fire ant (LFA) Pesticide Treatment Coupon Pilot Project and site map, and requires a report to be submitted to the Legislature prior to the 2018 Regular Session. The Department offers comments on this measure.

The Department understands the harmful and invasive nature of LFA. As such, the Department has provided support to Hawaii County for a pilot program to combat LFA beginning with Hawaii County parks. The Department has also continually provided funding and support for the Hawaii Ant Lab, an organization that has been on the forefront in the fight against LFA and has created new and innovative methods to treat and eradicate LFA infestations. Furthermore, it is our understanding that the Hawaii Ant Lab is currently working on a map of known LFA infestations throughout the Big Island and further resources for the Hawaii Ant Lab could help them to finish this project and disseminate that information. The Hawaii County also has a similar voucher program to assist homeowners with education and access to affordable treatments.

The Department would like to note that the measure highlights the Department's "little fire ant program," when in fact no such formal program exists. The Department maintains duties and responsibilities within its Plant Industry Division to address pests such as the Little Fire Ant.

In regards to the coupon pilot project, the Department is concerned about the resources that would be required to monitor such a program. It would be very difficult for the Department, with its given resources, to verify and monitor if the pesticides were

being used for the purpose of controlling LFA or for other purposes. Additional resources would be needed to carry out the scope identified in this measure.

Thank you for the opportunity to testify on this measure.

DAVID Y. IGE
GOVERNOR OF
HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA
FIRST DEPUTY

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

Testimony of
SUZANNE D. CASE
Chairperson

Before the Senate Committee on
AGRICULTURE AND ENVIRONMENT

Monday, March 13, 2017
1:15 PM
State Capitol, Conference Room 224

In consideration of
HOUSE BILL 481, HOUSE DRAFT 1
RELATING TO INVASIVE SPECIES

House Bill 481, House Draft 1 proposes to require the Department of Agriculture (DOA) to establish a pilot pesticide treatment coupon project and little fire ant site map for the County of Hawaii. **The Department of Land and Natural Resources (Department) supports this initiative, as long as it does not replace our priorities requested in the Executive Budget.**

The Department is the administrative host of the Hawaii Invasive Species Council, which in Fiscal Year 2017 funded a similar project with the County of Hawaii. The Department notes that the Program described by this measure would provide homeowner assistance in temporarily decreasing the presence of ants on private land, but that it is not a long-term control or eradication strategy. The Department supports this measure, provided that its passage does not impact long-term control and eradication projects managed by DOA or the Hawaii Ant Lab (a project of the University of Hawaii).

Thank you for the opportunity to comment on this measure.

Written Testimony Presented Before the
Senate Committee on Agriculture and Environment
Monday, March 13, 2017 at 1:15 p.m.
By
Rachel Novotny, Interim Dean
And
J. Kenneth Grace, Associate Dean
College of Tropical Agriculture and Human Resources
University of Hawaiʻi at Mānoa

HB 481 HD1 – RELATING TO INVASIVE SPECIES

Chair Gabbard, Vice Chair Riviere and members of the committee:

Thank you for the opportunity to provide <u>comments</u> on HB 481 HD1, which asks the Department of Agriculture to establish a pilot pesticide treatment coupon project and a little fire ant site map for the county of Hawaiʻi, requires a report to the Legislature on project implementation, and appropriates funds for these purposes.

With training on pesticide safety and effective control techniques, involvement of the public in efforts to control invasive species, given the limited resources available to government agencies, is a potentially useful approach, and the pilot project could create a model for management of other persistent invasive species in the state.

We defer to the Department of Agriculture on fiscal and management implications of HB 481 HD1, but we support the intent of the bill to involve the public in efforts to control invasive pests. We suggest that appropriate funding and resources for public education in safe and effective pest control techniques be included in the pilot project.

Harry Kim
Mayor
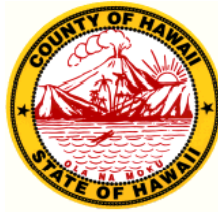
Wil Okabe
Managing Director

Barbara J. Kossow
Deputy Managing Director

County of Hawai'i
Office of the Mayor

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(808) 323-4444 • Fax (808) 323-4440

Dear Chair Gabbard and members:

      Re: Invasive species—HB 186 (coffee beetle)
                  HB 481 (fire ant)
                  HB 1301 (liability)
   HB 1339 (restructuring)

You have several bills on today's agenda dealing with invasive species, including HB 186, HD1; HB 481, HD1; HB 1301, HD2; and HB 1339, HD1. Although I am reluctant to single out one bill over another, and defer to your good judgment as to the merits of each, I do want to urge that funding to fight the coffee berry borer beetle (HB186) and little fire ants (HB481) should be approved if at all possible.

Beyond that, I primarily want to thank you for the attention that this issue is getting from you. The Council of Mayors has identified invasive species as a top-priority that deserves all our attention. Even our best efforts are often inadequate to protect our islands from harmful pests, and limited resources make it imperative that we work together in pursuing solutions to what often seem intractable problems.

With the possible exception (so far) of the parakeet problem, it seems that Hawaii County has suffered a disproportionate share of the damage caused by invasive species, including coffee berry borer beetle, little fire ants, coqui frogs, rapid ohia death and probably others. But all our islands, and all our constituents, are at risk. My primary request to you would be "Please don't give up." As a county, we do not have the resources or expertise to fight these devastating invaders on our own. We need as much assistance from you as you can offer.

Respectfully submitted,

Harry Kim
Mayor
County of Hawaii

COUNTY OF HAWAI'I STATE OF HAWAI'I
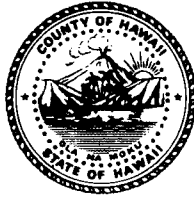
RESOLUTION NO. **61 17**

(DRAFT 2)

A RESOLUTION URGING THE HAWAI'I STATE LEGISLATURE TO APPROVE SENATE BILL NO. 656 AND HOUSE BILL NO. 481 TO ADDRESS THE THREAT OF THE LITTLE FIRE ANT.

WHEREAS, the continued spread of the invasive species known as the Little Fire Ant (LFA) threatens native biodiversity, alters tropical ecosystems, impairs human health, impedes tourism, diminishes agricultural productivity, mars horticulture sales, and blinds pets; and

WHEREAS, Senate Bill No. 656 and House Bill No. 481 in the 2017 session of the Legislature will fund a project administered by the Hawai'i Department of Agriculture to address the spread of LFA; and

WHEREAS, a December 2016 article published in the Proceedings of the Hawaiian Entomological Society ("Exhibit A") chronicles how LFA has become established on Hawai'i Island, and how periodic infestations have been addressed on Kaua'i, O'ahu, and Maui; and

WHEREAS, LFA concentrations can reach 20,000 per square meter, or nearly 1,900 per square foot; and

WHEREAS, a March 2015 article published in the academic journal "Ecological Economics" ("Exhibit B") models the growth and spread of LFA on Hawai'i Island and estimates that an increase of $8 million to manage the ant during the next two to three years would save $5.496 billion in reduced control costs, $538 million in economic damages, 2.161 billion human sting incidents, and 762 million pet sting incidents over the next 35 years; and

WHEREAS, the "Ecological Economics" article states that "In the next 35 years the cost of Little Fire Ant under current management will balloon to $6.1 billion. With efforts to suppress Little Fire Ant populations, under least cost management, net costs drop to $51 million, a substantial savings to the local economy"; and

WHEREAS, Hawai'i County has continued treating sites infested with LFA at County parks for the benefit of residents and visitors; and

WHEREAS, Hawai'i County's efforts have been funded by the Hawai'i Department of Agriculture, the Hawai'i Tourism Authority, and the Hawai'i Invasive Species Council; and

WHEREAS, Hawai'i County continues to seek support to continue funding LFA control operations; and

WHEREAS, the "Proceedings of the Hawaiian Entomological Society" article proves that multi-agency collaboration and funding are crucial for a biosecurity plan to contain the spread of LFA throughout the State; and

WHEREAS, the Hawai'i Department of Agriculture's project includes the distribution of coupons for pesticide treatment and a mapping of all LFA sites in the County of Hawai'i; now, therefore,

BE IT RESOLVED BY THE COUNCIL OF THE COUNTY OF HAWAI'I that the House and Senate are urged to approve Senate Bill No. 656 and House Bill No. 481 to address the threat of the Little Fire Ant in Hawai'i.

BE IT FINALLY RESOLVED that the County Clerk shall transmit a copy of this resolution to the Honorable Governor David Y. Ige, the Honorable Senate President Ronald D. Kouchi, the Honorable Speaker Joseph M. Souki, the Honorable Senator Jill N. Tokuda, the Honorable Senator Donovan M. Dela Cruz, the Honorable Senator Mike Gabbard, the Honorable Senator Gil Riviere, the Honorable Representative Sylvia Luke, the Honorable Representative Ty J.K. Cullen, the Honorable Representative Chris Lee, the Honorable Representative Nicole Lowen, the Honorable Representative Richard P. Creagan, and the Honorable Representative Lynn DeCoite.

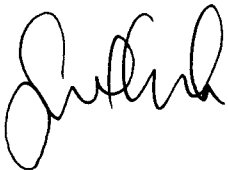Dated at _____Kona_____, Hawai'i, this _22nd_ day of _____February_____, 20_17_.

INTRODUCED BY:

_____
COUNCIL MEMBER, COUNTY OF HAWAI'I

COUNTY COUNCIL
County of Hawai'i
Hilo, Hawai'i

I hereby certify that the foregoing RESOLUTION was by the vote indicated to the right hereof adopted by the COUNCIL of the County of Hawai'i on ___February 22, 2017___.

ATTEST:

_____   _____
COUNTY CLERK   CHAIRPERSON & PRESIDING OFFICER

ROLL CALL VOTE				
	AYES	NOES	ABS	EX
CHUNG	X			
DAVID			X	
EOFF	X			
KANUHA	X			
LEE LOY	X			
O'HARA	X			
POINDEXTER	X			
RICHARDS	X			
RUGGLES	X			
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Reference: _____C-88.2/GREDC-2_____

RESOLUTION NO. **61 17**

(DRAFT 2)

2

The History of Little Fire Ant *Wasmannia auropunctata* Roger in the Hawaiian Islands: Spread, Control, and Local Eradication

Casper Vanderwoude[1], **Michelle Montgomery**, **Heather Forester**,
Ersel Hensley, and **Michael K. Adachi**
Hawaii Ant Lab, Pacific Cooperative Studies Unit, University of Hawaii at Manoa,
16 E. Lanikaula St Hilo, Hawaii. [1]Corresponding author: casperv@hawaii.edu

Abstract. The islands of Hawaii have been the battleground for successive "invasion waves" by exotic ants for over a century. The arrival of *Pheidole megacephala* (Fabricius) (the big headed ant) in the late nineteenth century, was followed in 1939 by *Linepithema humile* (Mayr) (the Argentine ant) and *Anoplolepis gracilipes* (fr. Smith), (the longlegged Ant) in 1953. The most recent arrival is the little fire ant (*Wasmannia auropunctata* Roger) which was first recorded in 1999. This paper chronicles the subsequent spread of *W. auropunctata* through the Hawaiian archipelago. Initially introduced and spread via the import and sale of nursery plants, *W. auropunctata* is now well-established on the island of Hawaii. Ubiquitous on the windward side of Hawaii island, *W. auropunctata* are now being transported not only via nursery plants but also via non-agricultural products. The prevention, detection and response to *W. auropunctata* introductions is addressed by informal and *ad hoc* partnerships between a number of agencies, each contributing to preventing and reducing spread of this species. The draft Hawaii Inter-Agency Biosecurity Plan recognizes and strengthens these partnerships and will contribute positively to Hawaii's biosecurity system.

Key words: invasive ants, Hawaii, W*asmannia auropunctata*, biosecurity, biological invasions, Pacific, little fire ant

Introduction

Native ants are thought to be naturally absent from the islands of the eastern Pacific, including those of the Hawaiian archipelago (Wilson and Taylor 1967). All ant species currently recorded in Hawaii are widespread cosmopolitan tramp species that have been introduced by human travel and commerce (Krushelnycky et al. 2005). The biota of Hawaii has evolved in the complete or nearly complete absence of ants, which most likely resulted in an ecological predisposition to invasions by exotic ant species along with increased impacts such invasions may cause (Reimer et al. 1990). The number of new ant species has accumulated steadily over time to 47 (Krushelnycky et al. 2005), with the current number of species a little higher due mostly to taxonomic revisions.

Of these, four ant species are especially noteworthy due to their ecological and economic impacts worldwide, featuring prominently in the IUCN list of the world's worst invasive species (Lowe et al. 2000). The bigheaded ant (*Pheidole megacephala* (Fabricius)) was first recorded in Hawaii as early as 1879 (Smith 1879), at which time it was already well established. In the years that followed,

entomologists lamented the dearth of native Coleoptera wherever *P. megacephala* had become established (Perkins 1913). Their association with mealybugs and other common plant pests caused crop losses, especially in pineapple (Beardsley et al. 1982, Jahn and Beardsley 1994). In the 1939, the Argentine ant (*Linepithema humile* (Mayr)) was detected on the island of Oahu (Zimmerman 1940, Reimer 1994). Primarily considered a nuisance species, Argentine ants spread quickly to the neighboring islands. The ensuing battle for territory between *L. humile* and *P. megacephala* saw the new invader restricted to higher elevation habitats where it caused considerable impacts to native ecosystems (Medeiros et al. 1986, Cole 1992, Krushelnycky and Gillespie 2008). In 1953, a new invader, *Anoplolepis gracilipes* (fr. Smith) (the longlegged ant, also known as the yellow crazy ant) arrived at the US Naval base, Pearl Harbor (Clagg 1953). A shade-tolerant species, *A. gracilipes* thrived in shaded lowland environments, preying on birds and invertebrates (Gillespie and Reimer 1993). Capable of episodic population explosions, *A. gracilipes* forms dense super-colonies that drive out other fauna and at some locations, can cause the collapse of plant communities (O'Dowd et al. 2003).

In 1999, the little fire ant (*Wasmannia auropunctata* Roger) was detected on the island of Hawaii (Conant and Hirayama 2000). This ant species has a native range that includes South America and the Caribbean (Wetterer and Porter 2003), but has invaded many Pacific islands, West Africa, Australia, Florida, and Israel (Wetterer 2013). Genetic comparisons with material from native and introduced locations suggest Florida is the putative source of the Hawaii introduction (Mikheyev and Mueller 2007, Foucaud et al. 2010). Here, we describe the spread of this species through the Hawaiian islands between 1999 and 2016 and discuss likely introduction pathways.

Methods and Materials

We used published and unpublished literature as well as personal communications and observations from others involved with the response to this introduction to document the spread of *W. auropunctata* from the date of the initial detection to the present (2016).

History of Introduction and Spread

The state of Hawaii is located in the central Pacific Ocean, approximately between longitudes 154–160° west, and latitudes 19–22° north. It is made up of eight separate islands, of which, six are accessible by the general public: Hawaii, Oahu, Maui, Kauai, Molokai, and Lanai. Since the initial discovery in 1999, *W. auropunctata* has become established on the four most populous islands (Oahu, Hawaii, Maui, and Kauai). The spread, to and within, each island, is detailed below.

Hawaii island. In 1999, Conant and Hirayama (2000) reported the presence of *W. auropunctata* at 13 locations in the South Hilo district on the island of Hawaii (the Big Island). Initially, *W. auropunctata* was observed on three infested properties in Hawaiian Paradise Park south of Hilo. Soon thereafter, additional infested locations were discovered at Kapoho and Paipaikou. Most infested locations were commercial nurseries or agricultural properties that had recently planted windbreaks of *Caryota* sp. (fish-tail palm) (P. Conant pers. com). Subsequent public outreach, e.g. Gruner (2000), and surveys revealed that *W. auropunctata* infestations were more widespread than first estimated, likely spread through the sale and movements of infested potted plants. Despite this challenge and a lack of resources, the Hawaii Department of
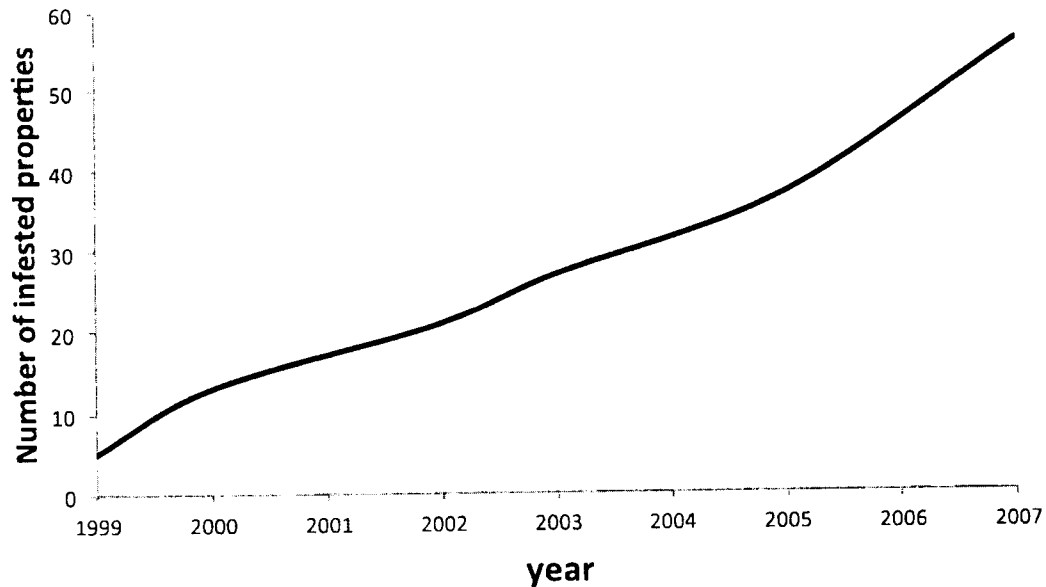
Figure 1. Number of known locations infested with *Wasmannia auropunctata* on Hawaii island between 1999 and 2007. Data sourced from Conant and Hirayama (2000); Motoki et al. (Motoki et al. 2013), P. Conant (pers. com.) and informal reports from Hawaii Department of Agriculture.

Agriculture (HDOA) responded by treating all known infested properties with baits. Between 1999 and 2007, the number of separate known infestations increased from an initial 3 properties to 56 by 2007 (Figure 1). These properties were scattered between Kalapana (30 miles SE of Hilo) and Laupahoehoe (25 miles NW of Hilo) (Figure 2) spanning some 55 miles to an elevation of 1,500 ft a.s.l.. However, the actual number of infested properties within these boundaries was probably much higher (P. Conant, pers. com) as the number of known sites was a reflection of survey effort, increasing levels of public awareness and actual spread.

The widespread and mostly unknown distribution of *W. auropunctata*, along with an inability to treat colonies established in the tree canopy (Souza et al. 2008), resulted in the continued spread of this species. By early 2010, *W. auropunctata* had spread to several locations on the west coast of Hawaii island (Vanderwoude

et al. 2010). New infestations continued to be detected beyond the original Kalapana-Laupahoehoe area and now include most of the west side of Hawaii island, Waipio Valley, Hawi, Kapaau, Holualoa, Naalehu, Captain Cook, and Waimea. In districts with lower rainfall, *W. auropunctata* are limited to favorable microclimates near homes and other structures that feature artificial landscaping and irrigation (C.V. pers. obs.). This concurs with the observations of Vonshak in Israel (Vonshak et al. 2010). By end 2010, the estimated number of infested properties island-wide had exceeded 4,500, growing to an estimated 6,400 by end 2012 (Lee et al. 2015). Figure 3 shows areas on Hawaii island currently infested with *W. auropunctata*.

Kauai. At about the same time as the initial detection (October 1999), plants from an infested nursery on Hawaii had been shipped to the island of Kauai. These plants were infested with *W. auropunctata* colonies. The plants and adjacent
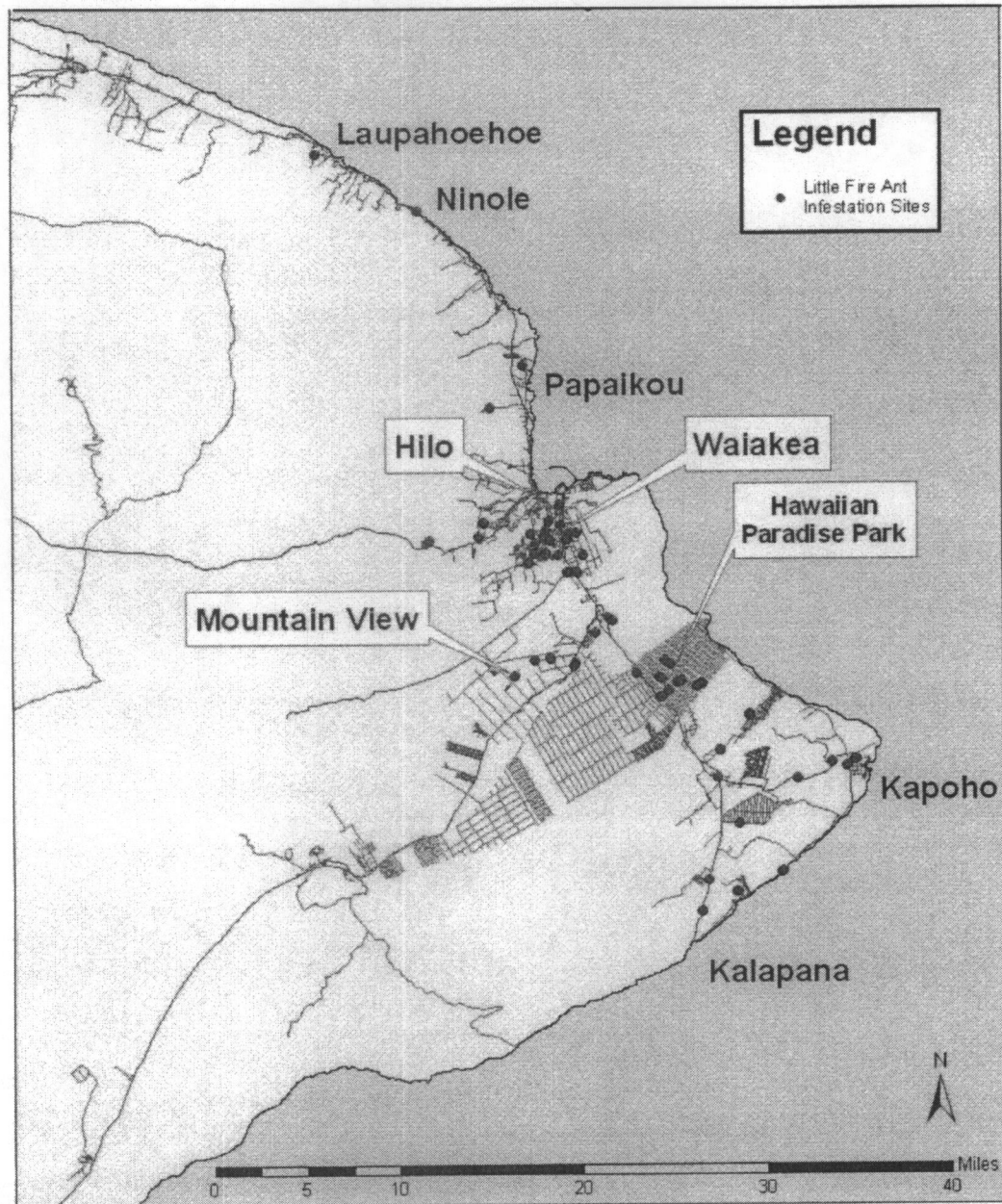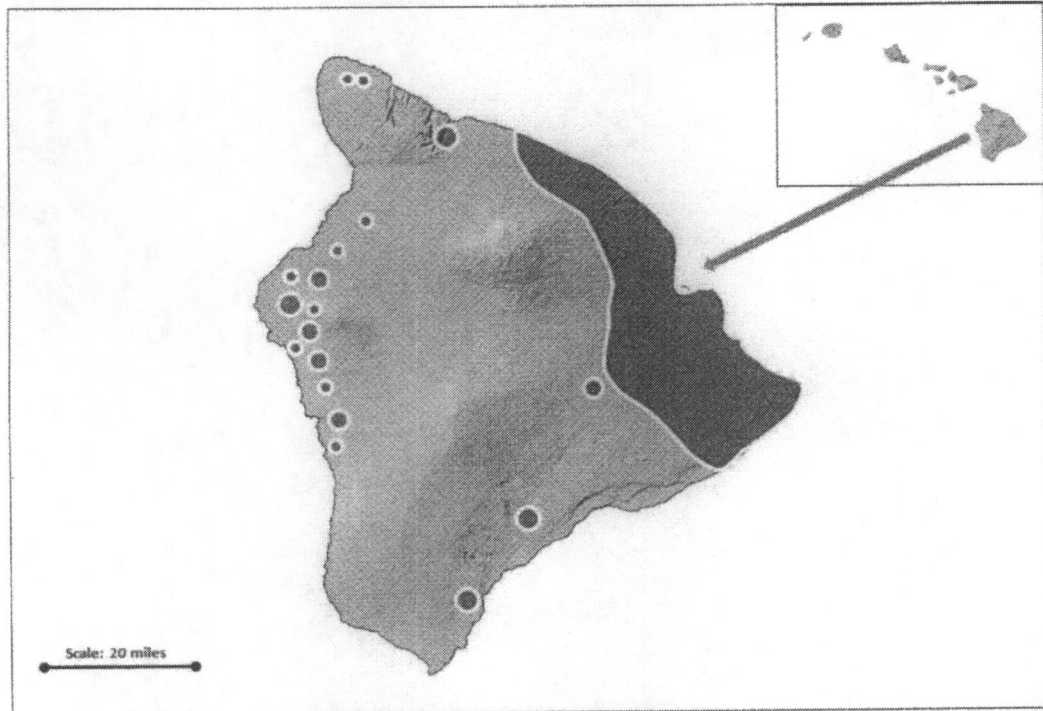
Figure 2. Location of properties infested with *Wasmannia auropunctata* in January 2007 prepared by Hawaii Department of Agriculture.

areas were immediately treated with baits to prevent further spread within Kauai (Conant and Hirayama 2000). This infestation was assumed eradicated. However, *W. auropunctata* were recorded in a follow-up survey at the site four years later in September 2003 (Null and Gundersen 2007). The infestation now covered five acres and had encroached onto an adjoining property (see Figure 4). The site was treated with granular baits followed by *ad hoc* retreatment and periodic surveys through to 2012. During these years, the infestation spread mostly westwards eventually spanning 12 acres and extending down a steep escarpment to Kalihiwai beach.

EXHIBIT A

Figure 3. Areas of Hawaii island currently infested with *Wasmannia auropunctata* (2016). (Not all properties in the larger shaded section are infested).
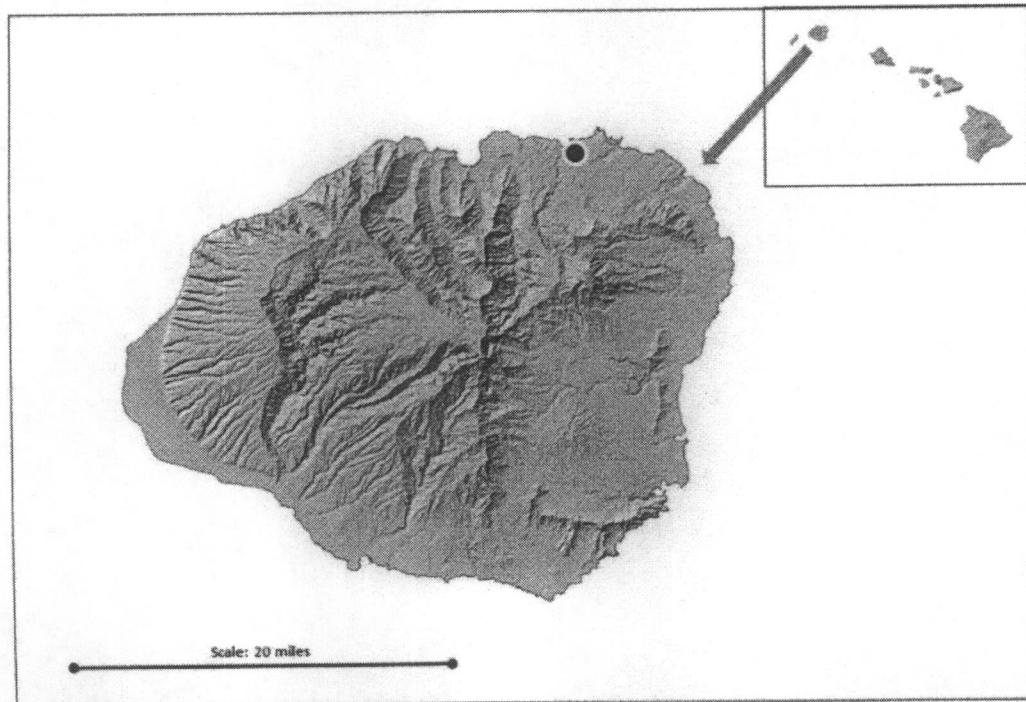
Figure 4. Map of Kauai showing location infested by *Wasmannia auropuntata* (2012). Currently this site is putatively ant free.
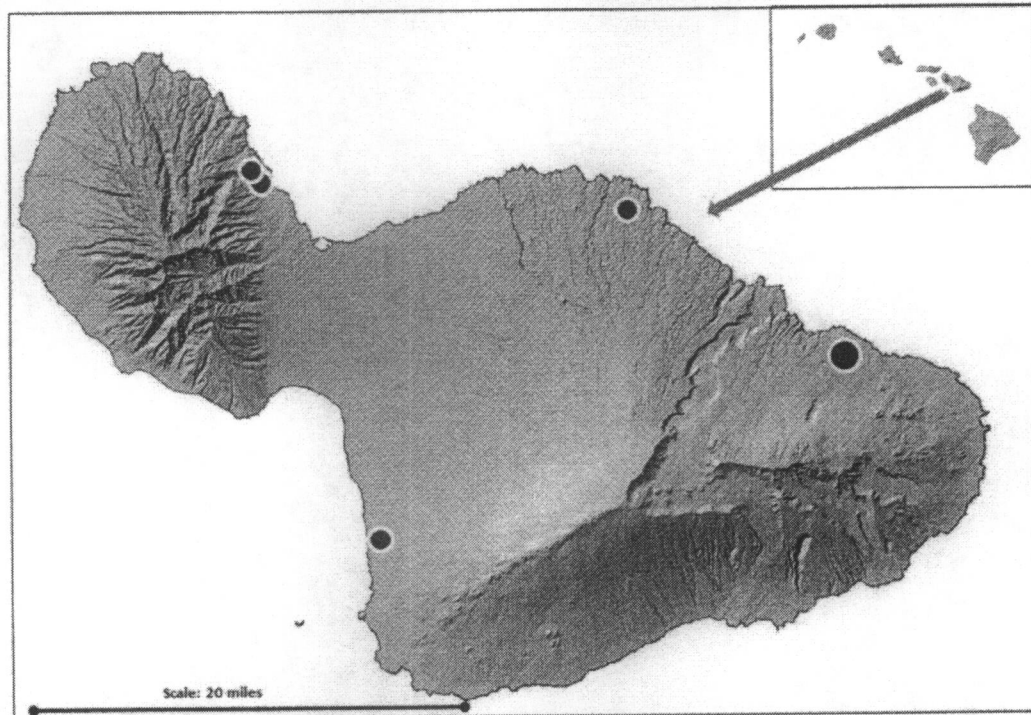
Figure 5. Locations of all known sites on Maui infested with *Wasmannia auropunctata*.

In late 2012, a second eradication attempt was implemented. At this time, the critical issues of bait efficacy (Hara 2013, Hara et al. 2014, Montgomery et al. 2015) and arboreal treatment (Vanderwoude and Nadeau 2009) had been largely resolved. Due to the complexity of the site and regulatory issues, this attempt was divided into two phases: initially focusing on the readily accessible areas and later addressing the escarpment and taller vegetation. To date (late 2016), results are encouraging. The entire site is putatively free of *W. auropunctata* with only a single known active colony detected beneath a taller tree. Monitoring of this site and treatment of the known small colony continues.

Maui. *Wasmannia auropunctata* have been detected multiple times on the island of Maui (Figure 5). The first LFA infestation detected on Maui was located in Waihee, immediately west of the main city of Kahului, in September 2009. A resident reported receiving painful stings from small ants on her property. Samples of these ants were submitted to the HDOA entomologist who confirmed it was *Wasmannia auropunctata*. An inter-agency taskforce was established, consisting of staff from the County of Maui, Maui Invasive Species Committee (MISC), HDOA, US Geological Survey, University of Hawaii, and the Hawaii Ant Lab (Hawaii Department of Agriculture 2009, Vanderwoude et al. 2010). Together they formulated an eradication plan which included treatment, outreach and delimiting elements (Vanderwoude et al. 2010). The ants were restricted to a single property and an island-wide delimiting survey of probable high-risk sites did not find additional infestations. The Waihee infestation was officially eradicated in April 2014.

In December 2013, a Maui resident, alerted by various outreach programs implemented by MISC, found *W. auropunc-*

tata on a hapuu log (*Cibotium* sp., a tree fern) purchased from a local landscaping supplier. The discovery prompted a larger investigation by HDOA who discovered that several shipments of hapuu logs, originating from the Big Island, were infested (Hawaii Department of Agriculture 2013). These shipments and subsequent distribution to retailers were located and inspected by quarantine officers. A number of these also had *W. auropunctata*. These were either destroyed or treated *in situ*. Two additional nascent infestations were found in south Maui (Wailea area) during the first half of 2014 and these have been eradicated by HDOA and MISC.

In September 2014, MISC field workers were stung by small ants while conducting other activities in Nahiku (near Hana, Maui). These ants were later identified as LFA and subsequent surveys found high density LFA in challenging rainforest terrain on both sides of the Hana Highway, extending 1½ miles along a drainage to the ocean. Four properties were involved. The infestation appeared to have spread downstream from an initial upstream establishment point to the ocean. The speed at which *W. auropunctata* spread downstream was substantially faster than normal lateral spread, most likely facilitated by the movement of infested debris during periodic flooding events. Due to the challenging nature of this infestation, agencies collaborating on the response (HAL, HDOA, Maui County and MISC) formulated a containment and aggressive control plan, first removing LFA from locations from which it would be likely to spread, then to later assess the possibilities for a more comprehensive approach. This plan is ongoing.

Another LFA discovery was made in Huelo in January 2015. An eradication plan has been developed and partly implemented. Activities at this site were hampered by the refusal of one resident to allow treatment staff access. This resulted in the HDOA taking the unusual step of obtaining a court order (Hawaii Department of Agriculture 2016), and later declaring a quarantine on the property in order allow the eradication program to continue at this site. The delays to treatment activities have allowed *W. auropunctata* to recover and spread further into this property, necessitating additional treatment effort.

The site at Waihee, which had been ant-free since 2010, was surveyed repeatedly between 2010 and 2014. In 2016 another survey was conducted at this site. *W. auropunctata* were again detected in an area immediately adjacent to the original treatment area. It is possible that some infested plant trimmings may have been moved there before the original detection in 2009. Only spanning an acre or so, this site is now being treated again to ensure no live ants remain.

Oahu. The detection of infested shipments of hapuu in Maui prompted HDOA to investigate other shipments from the same supplier destined for Oahu and Lanai. Some of these were also infested, and as a result, HDOA staff systematically surveyed the retail stores that received these items. Several of these retail stores also had become infested, and these were systematically treated by HDOA staff (Hawaii Department of Agriculture 2013).

The increased publicity surrounding the infested hapuu led to the discovery of two well-established infestations on Oahu, each covering approximately five acres (Figure 6). One of these was located in abandoned agricultural land in Waimanalo and another in a suburban area of Mililani. Eradication plans were developed for each site and baits were applied repeatedly to both sites over the course of one year. One year after the last treatment was applied (2016), both sites are putatively free of LFA.
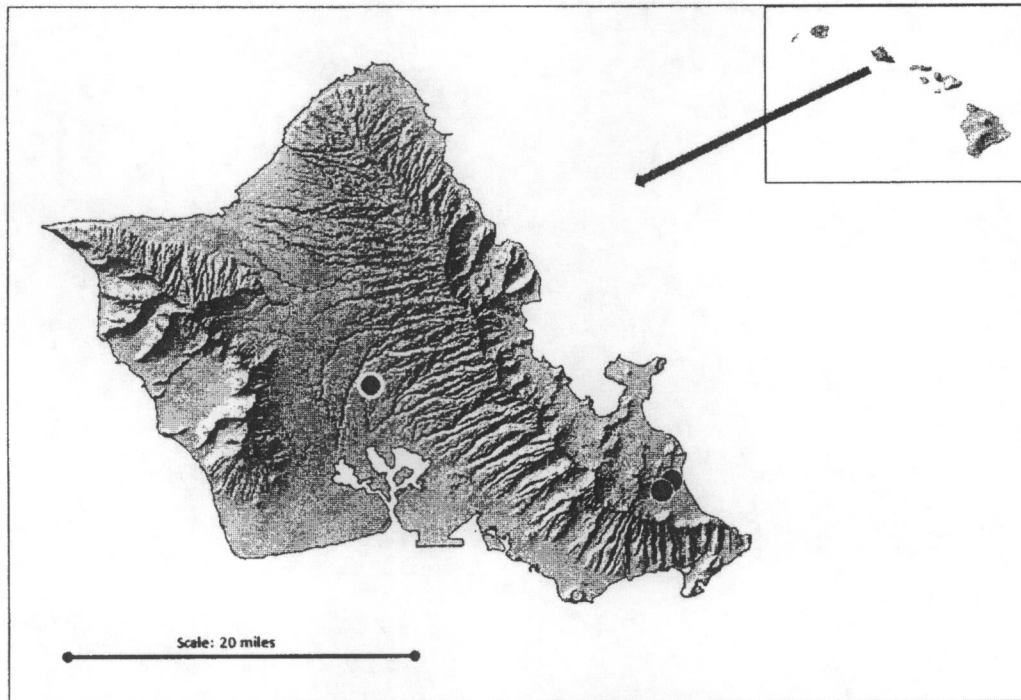
Figure 6. Locations of known sites on Oahu infested with *Wasmannia auropunctata*. (currently the infestation in Mililani and the original infestation in Waimanalo are putatively ant-free)

The movement of *W. auropunctata* to Maui and Oahu identified critical gaps in the biosecurity system. On Oahu, these gaps were addressed by implementing an ongoing island-wide survey of high-risk entry sites that began in January 2015 and continues to the present. This program was designed to complement existing regulation and inspection systems, with a goal to detect and eradicate infestations while small. During the past two years, this program has detected 16 nascent infestations at Oahu nurseries which were systematically treated. In late 2016 a large, 4-acre infestation was also discovered in Waimanalo (not linked to the original detection in the same district). Without this early detection, such infestations will grow too large to manage and become a source-point for jump-dispersal to new locations (Suarez et al. 2001).

Discussion

The worldwide spread of invasive ants began at least as early as the 16th century (Gotzek et al. 2015). By the beginning of the 20th century, the ecological impacts caused by these invasions were becoming apparent as entomologists lamented the paucity of other invertebrate fauna in locations invaded by ant species such as *Pheidole megacephala* (Tryon 1912, Perkins 1913). These invasions are widely regarded as a consequence of human commerce (Wilson and Taylor 1967, Passera 1994, McGlynn 1999, Holway et al. 2002), and in this regard, the recent introduction and spread of *W. auropunctata* is no exception.

Queens and males in invasive *W. auropunctata* populations are mostly produced through thelytokous parthenogenesis (Fournier et al. 2005). Clonal reproduc-

tion allows global invasion pathways of this species to be accurately reconstructed (Foucaud et al. 2010). Thus, the origin of *W. auropunctata* in Hawaii can be attributed to *W. auropunctata* from Florida, as one population is a clonal subset of the other (Foucaud et al. 2010). Further, there is an unambiguous connection with the nursery trade as the original vector, both for the initial introduction and subsequent early spread within Hawaii island.

Potted plants are an ideal vehicle for the movement of this species. The spaces between the potting medium, plant roots and the wall of plant containers are convenient nesting sites, and forms a moisture gradient that optimizes brood development (Holldobler and Wilson 1990 p374). *W. auropunctata* colonies are small, interconnected and typically possess a worker:queen ratio between 250 and 500 (Ulloa-Chacon and Cherix 1990). This virtually assures every plant within an infested nursery houses a viable *W. auropunctata* colony which can remain largely undetected. Further, by their nature, plant nurseries are effective distribution points. Together, these factors contributed to the rapid spread of this species within Hawaii Island, mirroring the historical spread of this species through southern Florida via the movement of potted plants and balled citrus seedlings (Spencer 1941).

The pathways for movement of *W. auropunctata* between the Hawaiian islands have become more diverse as this species became increasingly ubiquitous. After the initial discovery in 1999, HDOA further regulated the movement of plants and propagative plant materials between islands. Regulatory intervention included a requirement for exporting nurseries to be certified by HDOA, or for each shipment to neighbor islands to be inspected before shipment. Without this increased watchfulness, the inter-island movement of *W. auropunctata* would undoubtedly

have been much more rapid. However, at least some of the multiple infestations detected on Maui and Oahu are not linked to the nursery trade in any way. For example, no links between the purchase of potted plants and infestations in Nahiku, Huelo, Waihee and Mililani could be found.

The majority of ant-infested agricultural commodities shipped between Hawaii Island and other islands is detected and prevented from arriving by means of a thorough and careful system of regulation and inspection implemented by HDOA. Inspection systems are based on a risk-management approach that utilize available resources to optimize risk reduction. However, not all infested commodities are (or can be) detected at the border. As *W. auropunctata* become increasingly ubiquitous on Hawaii island, the variety and proportion of infested cargoes increases beyond simply "nursery plants" to include non-agricultural items such as general cargo, household items and vehicles. A percentage of infested plants and other non-regulated material will continue to arrive as a result of slippage (Whyte 2006)—infested goods that bypass regulated pathways, escape detection or are in commodity categories that are not inspected.

By its very nature, slippage is difficult to quantify, and occurs in four commodity classes: those that bypass the biosecurity system, false negatives (infested material inspected and cleared), commodities excluded from inspection and commodities that do not fall within the HDOA mandate (Government of Hawaii 1973). Not all pathways are adequately regulated. Air passengers carrying plants and other propagative material between islands are not inspected due to a lack of resources. The rate of false negatives is likely to be very low, but remains largely unknown. Hawaii Administrative Rules (Hawaii Administrative Rules 2012) limit commodity

inspections to "plants and propagative material." The rules also acknowledge that HDOA has legislative authority to inspect a wider range of commodities such as foliage, cut flowers and produce, but self-limits activities to "periodic random inspections." Finally, there are no systematic inspections of other commodity classes (used vehicles, machinery, household effects etc.) because HDOA does not have legislative authority to do so.

Detection and response to these introductions demonstrates the complementary roles of prevention through regulation and inspection; early detection through increased awareness and surveillance, and rapid response through multi-agency collaboration. These elements of the Hawaii biosecurity framework are performed by different and sometimes multiple agencies (Kraus and Duffy 2010) often through semi-formal or *ad hoc* collaborations. Regardless of the multitude of funding partners, agency governance issues, obstacles to data sharing, complex legal considerations, and the often difficult operational impediments, these collaborations can be startlingly effective, as evidenced by the rapid detection, response, and treatment of multiple *W. auropunctata* infestations throughout Hawaii. Of the eight infestations on the neighbor islands of Oahu, Kauai and Maui, five sites are putatively free of *W. auropunctata* and the remaining three are contained and continue to be treated. A biosecurity plan that brings these agencies closer and recognizes these collaborations, is currently being drafted by the State of Hawaii (Anon 2016), and will serve as a blueprint for biosecurity activities in the next decade.

As *Wasmannia auropunctata* spread through the islands of Hawaii, the economic and ecological impacts are likely to be catastrophic. The predicted economic costs to the island of Hawaii alone are likely to exceed $100 million annually

(Lee et al. 2015). Continued prevention, early detection and response to new incursions on islands other than Hawaii island is an invaluable investment in the future of the unique and fragile ecosystems that Hawaii has to offer.

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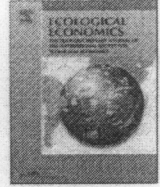
Analysis

Taking the sting out of Little Fire Ant in Hawaii

CrossMark

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ABSTRACT

In the 1990's, Little Fire Ants (LFAs) found its way to the island of Hawaii, most likely traveling with a shipment of potted plants from Florida. These plants were subsequently sold to consumers along the east coast of the Island, along with Little Fire Ant colonies living in the potting medium. LFA is now thriving and continues to spread. Fifteen years after the initial detection in 1999, LFA has spread to over 4000 locations on the island of Hawaii and has been found in isolated locations on Kauai, Maui, and Oahu Islands. Current efforts are expected to contain the infestations on the other islands but significant additional investment is needed to halt the rapid spread of LFA on the island of Hawaii.
Increased management expenditures can suppress infestations; reduce spread between sectors; and decrease long-term management costs, damages, and stings.

- An immediate expenditure of $8 million in the next 2–3 years plus follow-up prevention, monitoring, and mitigation treatments will yield $1.210 billion in reduced control costs, $129 million in lowered economic damages, 315 million fewer human sting incidents, and 102 million less pet sting incidents over 10 years.
- Over 35 years, the benefits include $5.496 billion in reduced control costs, $538 million less economic damages, 2.161 billion fewer human sting incidents, and 762 million fewer pet sting incidents.

1. Introduction

1.1. Problem Statement

Wasmannia auropunctata (roger), known as the Little Fire Ant (LFA), 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 (Lowe et al., 2000). Little Fire Ant will sting endangered reptiles and birds, interfering with reproduction, nesting, and survival of young. They also sting cats, dogs and other domestic animals in the eyes, blinding them over time (Theron, 2005). Humans are also stung by this species, both indoors and outdoors. The sting typically causes an intense burning sensation and painful itchy welts. Human habitats provide ideal niches for Little Fire Ant growth and survival (Krushelnycky et al., 2005). Human activities disperse Little Fire Ant quickly and widely.

1.2. Research Statement[1]

The purpose of this research is to assess the long term impacts of Little Fire Ant in Hawaii and to ascertain the economic and social benefit from greater public investment in prevention and control.

We developed a multi-sector, dynamic, stochastic, bioeconomic model to simulate LFA spread, human response, economic damages,

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[1] Abbreviations used in this article: LFA, HDOA.

and social impacts. We parameterized the model with government data, primary survey data, and information from experts and practitioners. We specified several levels of management and simulated outcomes with Microsoft Excel using Frontline Risk Solver Platform©.

1.3. Background

Ants were first introduced when the Europeans settled the islands, in the 18th century. Hawaii is now home to 47 introduced ant species (Krushelnycky et al, 2005); with the recent introduction Little Fire Ant *W. auropunctata* regarded as potentially the most destructive. USDA-ARS (2010) estimate that total damages, losses and control costs attributed to invasive fire ants in the United States is $5.6 billion per year.

Little Fire Ant arrived on the island of Hawaii most probably in the 1990's and by the time the infestation was detected in 1999 (Conant and Hirayama, 2000), Little Fire Ant had spread to 13 separate locations. Aggressive control actions were undertaken immediately, however Little Fire Ant continued to spread (Conant, 2002) and by 2004, infested 31 locations (Fig. 1). In the years following its initial detection, Little Fire Ants have spread to three other islands in the Hawaii archipelago: Maui, Kauai (Vanderwoude et al., 2010) and Oahu in late 2013.

The source of Little Fire Ants found in Hawaii is most likely Florida USA. Little Fire Ants have an unusual form of reproduction. In introduced populations, almost all female reproductive offspring are genetically identical to the parent female and males are genetically identical to the male parent. This clonal form of reproduction allows the source of new invasive populations to be traced to the source population with a high degree of certainty. Foucaud et al. (2010) determined that the clonal lines of Little Fire Ants in Hawaii are identical to those of introduced populations in Florida USA.

Due to the severity and extent of impacts, LFA is considered among the world's worst invasive species (Lowe et al., 2000). In homes, schools, lodging, and parks, Little Fire Ant will sting adults, infants, children and pets. The reaction to stings varies from person to person. Some people experience a severe reaction with a great deal of pain and large raised welts that itch for a week or more. Babies can receive numerous stings within a few minutes of exposure. Pets are stung in the eyes and over

several years lose their sight (Theron, 2005). Little Fire Ant infestations put agriculture crops and workers at risk (Fabres and Brown, 1978). When Little Fire Ant is present, aphid populations explode due to mutualism (Fasi et al., 2013) and farm workers are stung repeatedly. Plant nurseries can and have gone out of business due to lost productivity, high treatments costs, and a reluctance by consumers to buy infested stock. Wild honeybee hives in Hawaii have been swarmed and destroyed by LFA.

Once established, Little Fire Ant can occupy their habitat at an extraordinarily high density. Souza et al. (2008) estimate that total population size can exceed 200 million ants per hectare with worker:queen ratios of approximately 400 (Ulloa-Chacon and Cherix, 1990). This equates to a density of 20,000 ants per square meter, of which 40 will be queens.

Best-practice mitigation activities for affected residents and businesses comprise a regular (six weekly) application of granular baits to exterior areas combined with the use of residual pesticides both inside and on the exterior of structures. The Hawaii Ant Lab (University of Hawaii), with a staff of five people, provides research, outreach, education, training, advice and limited mitigation activities for all invasive ant issues in the state of Hawaii including maintaining a website[2] with information on impacts and remedies. The Big Island Invasive Species Committee provides education and outreach on Little Fire Ant and other invasive species on the island of Hawaii.

In modeling invasive species management, Mumford and Norton (1984) applied Bayesian decision theory to determine the timing and level of management as a function of the invasive species population density. Eiswerth and Johnson (2002) and Eiswerth and van Kooten (2002) incorporated dynamics to model population growth and uncertainty to allow for weather variability. To obtain closed-form solutions to the optimal invasive species management problem, Burnett et al. (2007), Carrasco et al. (2010), Mehta et al. (2007), Taylor and Hastings (2004), and Olson and Roy (2003) assumed a continuous rate of spread and employed optimal control modeling. Leung et al. (2002) modeled discrete invasive species spread employing stochastic dynamic programming.

Prevention management including monitoring invasion pathways associated with trade, transport and travel and inspecting potential vectors was modeled by Perrings (2005). Olson (2006) modeled invasive species introduction as a random variable and included prevention as a means to reduce the probability of introduction. Leung et al. (2002) specified prevention success as exponentially distributed and diminishing with effort. Mehta et al. (2007) indicated that prevention may do little to stop spread when the probability of introduction is small or when the number of invasion pathways is large, and modeled detection as a means of locating new introductions before they have had a chance to spread, where the probability of detection increases with the level of effort.

New introductions and established infestations require mitigation treatment in the form of chemical, mechanical, and manual means to reduce or eliminate the infestation. Treatment effectiveness as a stochastic process that decreases with effort was modeled by Feder (1979). The effectiveness of successive treatments was modeled with a cumulative probability distribution by Lichtenberg and Zilberman (1986). Olson and Roy (2003) used dynamic programming to determine the conditions under which eradication, mitigation, and no mitigation are optimal.

The marginal cost of invasive species management was modeled as a linear function that increased with the size of the infestation by Hastings et al. (2006) and Burnett et al. (2007); as a convex function by Olson (2006); and as a budget constrained function by Taylor and Hastings (2004), and Hastings et al. (2006). The marginal economic damage caused by the infestation was modeled as a linear function that
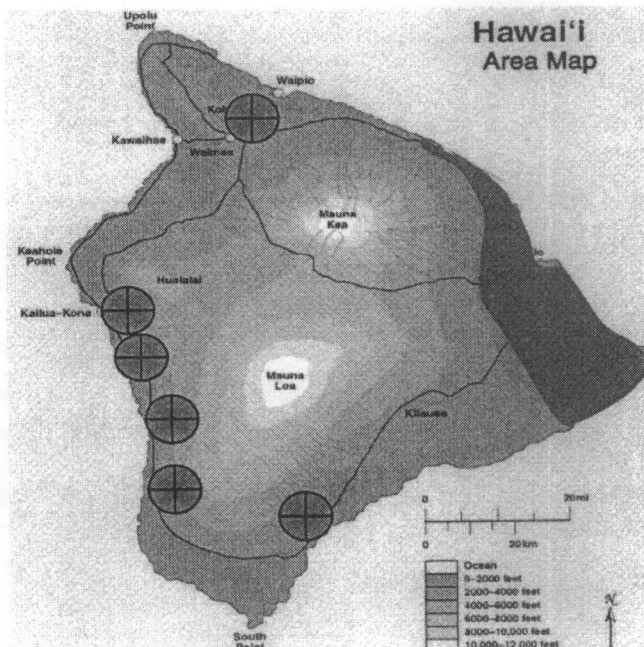

Fig. 1. Regions on Hawaii Island with one or more infested locations (red). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

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[2] www.littlefireants.com.

increased with the size of the infestation by Gutrich et al. (2007); as a quadratic function by Burnett et al. (2007); and as a non-linear function by Olson (2006) and Haight and Polasky (2010).

Leung et al. (2002), Burnett et al. (2007), and Eiswerth and van Kooten (2002) modeled invasive species population growth up to a carrying capacity over discrete time using a logistic function. Lee et al. (2007) modeled invasive species growth and spread overtime using a transition matrix to forecast the probability of uninfested locations becoming invaded, and then tracking that status of the infestation from incubating, to propagating, to spreading to other locations. Carrasco et al. (2010), Leung et al. (2002), and Burnett et al. (2007) simulated short distance dispersal via colony budding using a reaction–diffusion model. Suarez et al. (2001), Souza et al. (2008), and Wilson et al. (2009) modeled unlimited carrying capacity and long distance human mediated dispersal. Nathan et al. (2003) used gravity models to quantify human-mediated long distance dispersal. Hastings et al. (2005), and Bossenbroek et al. (2001) used commerce and traffic flows to model human-mediated dispersal pathways. Carrasco et al. (2010) assumed outward dispersal via a random walk process and used diffusion models. Eiswerth and van Kooten (2002), Kot and Schaffer (1986), Hastings et al. (2005), and Law et al. (2003) employed a probabilistic transition function[3] to model dispersal. Scanlan and Vanderwoude (2009) modeled dispersal using a stochastic cellular automata.

2. Materials and Methods

2.1. Model Framework

We simulate future spread and impacts from LFA on the island of Hawaii using a bioeconomic model comprised of three integrated sub-models: impact, management, and spread. Control variables determine the level of effort allocated toward LFA detection, spread prevention, and mitigation treatment.

2.1.1. Impacts
The impact sub-model quantifies economic impacts (economic damage and management expenditure) and social impacts (the number of human and pet LFA sting incidents) per sector over time. Economic damages are sector dependent and vary with the size and extent of the infestation. Management expenditures are based on best management practices and current technology and vary with management goals, management effort, and the cost of labor and materials. Sting incidents are based on the number of infested locations in each sector, human population, pet population, demographics, and employment in each sector. A sting "incident" may involve multiple LFA stings.

2.1.2. Management
The management sub-model quantifies the effect of management decisions on LFA survival, growth and dispersal. Management activities include detection, prevention, and mitigation treatment. Detection allows new infestations to be treated before they become established. Prevention reduces the likelihood that LFA will be transported to another location by humans. Mitigation treatments reduce the intensity and extent of infestations.

2.1.3. Spread
The spread sub-model simulates LFA survival, growth and dispersal as follows. When LFAs are initially introduced to a new location their chance of surviving is low. If they survive, they go unnoticed for several years during which they have time to establish and increase in number. The first year after introduction, LFAs are comparatively easy to eradicate. Once they establish, they are difficult to eradicate, begin causing

damage, and start producing new colonies that can be transported to other locations.

2.1.4. Original Contribution
In previous models of invasive ants, spatial spread was forecast using radial and cellular specifications. Our approach is novel in that we model LFA spread within and across economic sectors over time. On the island of Hawaii, LFAs are transported unintentionally by humans with the movement of infested soil, produce, and other goods; mechanisms which do not follow a radial or cellular pattern. Further, LFA nests are tiny compared with the area they can impact; several tiny walnut-sized nests can disrupt the activities of an entire household or farm. Thus rather than units of length or area, we use discrete locations as our unit measure of "space", e.g. a home, a school, a farm, and a park. One unit represents one location. This pseudo-spatial approach provides us with a compact way of specifying and simulating the joint relationships between economic activity, LFA movement, LFA impacts (economic and social), and management response. Our second contribution is an accounting of the number of LFA stings and a comparison of the Pareto tradeoff between economic impacts and stings.

2.2. Model Scope and Detail

Our model includes ninety thousand locations on the island of Hawaii within seven economic sectors $i \in$ {nursery, agriculture, lodging, residential, parks, schools, and all others}. Of the ninety thousand locations, 4581 locations are infested initially. Our model simulates infestation 35 years $t \in$ {0...35} into the future. The number of locations per sector and initial LFA infestation is shown in Table 1.

2.2.1. Impacts
Impacts from LFA comprise economic damages, management costs, and human and pet sting incidents.

2.2.1.1. Economic Damages.
Economic damages are sector-specific and vary with the size and extent of the LFA infestation. For example, in the residential sector we include the impact of LFA on property values when homes are sold. In the lodging sector we include reduced revenues from decreased room occupancy and cheaper room rates. The economic damage per sector location is based on estimated mean economic impacts from LFA and is assumed to increase with the number of infested locations and overall level of infestation. The economic damage in sector i at time t is:

$$D_{i,t} = c_i^{damage} \frac{N_{i,t}^{establish\,2}}{N_i^{max}} . \tag{1}$$

Table 1
Little Fire Ant infested locations on the island of Hawaii in 2012.

Sector	% Infested	Infested locations	Total locations
Nursery	22.5%	170	757
Agriculture	4.0%	186	4650
Lodging	0.2%	1	468
Residential	7.0%	3648	52,216
Parks	3.9%	6	152
Schools	1.2%	1	84
Other	1.7%	568	32,547[a]
Total	5%	4581	90,874

From Motoki et al. (2013).[b]

[a] Hawaii Island is 2.58 million acres. With our 6 major sectors we account for 2.3 million acres. Our sector "other" consists of 0.28 million acres and 81,556 parcels (according to 2010 tax records). To scale the model, we represented the "other" sector with 32,547 locations.

[b] Using data from the Hawaii Ant Lab; information from the 2007 Census of Agriculture, the 2011 Visitor Plant Inventory, City-data.com, and the State of Hawaii Data Book, and 2013 PCSU Technical Report #186.

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[3] A transition matrix is a kernel without a functional form, matrix elements denote the probability of transitioning between states or spatial locations.

EXHIBIT B

Here c_i^{damage} is the average economic damage at locations where LFA has become established, $N_{i,t}^{establish}$ is the number of locations where LFA has become established in sector i at the end of time t; N_i^{max} is the number of locations in sector i that are susceptible to LFA. Thus, when sector i becomes fully infested, $N_{i,t}^{establish} = N_i^{max}$ and annual damage is $c_i^{damage} N_i^{max}$.[4]

For agricultural impacts we estimated yield loss to untreated crops. Agricultural damages are $600 per farm. For nursery impacts we estimated revenue losses due to banned exports. Nursery damages are $9000 per farm. For residential impacts we estimated reduced property values when the homes are sold. Residential damages are $1000 per property. For lodging impacts we estimated revenue losses due to reduced visitation and lowered rates. Lodging damages are $183,000 per property. For park impacts we attempted to capture ecosystem productivity losses due to destruction of wild bee hives and increased chick mortality of ground nesting birds. Using cost transfer methods, park damages are $2300 per acre. For "other" sector impacts we surveyed landowners and businesses to find out the most they would spend on LFA mitigation. "Other" sector impacts are $500 per location.[5]

2.2.1.2. Management Expenditures. Management cost parameters are based on current technology, best management practices, and current costs for materials and labor. Total management expenditure is a function of management goals, management decisions, and size of the managed area. Management activities include prevention, detection, and mitigation.

Prevention expenditure is proportional to the number of infested locations. Prevention expenditure $c^{prevent}$ is a function of unit cost $p_i^{prevent}$, number of known infested locations $N_{i,t}^{known}$ and prevention effort $d_{i,t}^{prevent}$ as follows:

$$c_{i,t}^{prevent} = p_i^{prevent} N_{i,t}^{known} d_{i,t}^{prevent} \qquad (2)$$

Detection (monitoring) expenditure is proportional to the number of uninfested locations. Detection expenditure is a function of the unit cost of detection per location $p_{i,t}^{detect}$, number of uninfested locations $(N_i^{max} - N_{i,t}^{known})$, and detection effort $d_{i,t}^{detect}$ as follows:

$$c_{i,t}^{detect} = p_{i,t}^{detect} \left(N_i^{max} - N_{i,t}^{known} \right) d_{i,t}^{detect} \qquad (3)$$

Mitigation treatments are applied to known infestations. Mitigation expenditure $c^{mitigate}$ is a function of unit cost of mitigation $p_i^{mitigate}$, number of infested location $N_{i,t}^{known}$, and mitigation effort $d_{i,t}^{mitigate}$ as follows:

$$c_{i,t}^{mitigate} = p_i^{mitigate} N_{i,t}^{known} d_{i,t}^{mitigate} \qquad (4)$$

Expenditures for mitigation treatments, prevention, and detection are summed to obtain total management expenditure in sector i at time t as follows:

$$M_{i,t} = c_{i,t}^{prevent} + c_{i,t}^{detect} + c_{i,t}^{mitigate} \qquad (5)$$

2.2.1.3. Total Cost. Economic damage $D_{i,t}$ and management expenditure $M_{i,t}$ are discounted and summed over time t to obtain an expression of the present value future total cost associated with LFA infestation:

$$Total\ Cost = \sum_{t=0}^{35} \delta_t \left(\sum_{i=1}^{7} D_{i,t} + M_{i,t} \right) \qquad (6)$$

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[4] The form of this equation is similar to Mehta et al. (2007).
[5] About $50/acre per year.

where $\delta_t = 1/(1 + r)^t$ is the discount factor, r is the annual discount rate, and i indexes the seven economic sectors: agriculture, nursery, residences, schools, lodging, parks, and all others.

2.2.1.4. Social Impacts. LFA stings cause extreme pain, high anxiety, and itchy welts. While other species of fire ants nest solely outdoors and on the ground, LFA will enter houses, nest under kitchen counters and in bedding, and crawl beneath clothing to sting people in their homes. Outdoors, LFA can nest in leaf litter, in bushes, and in trees dropping onto people who happen to brush by. Each encounter with LFA may entail multiple stings. Domestic animals and pets are particularly susceptible to LFA stings. In infested residential areas, LFAs have repeatedly stung cats and dogs in the eyes inevitably blinding the animals over time.

We used Census data (DEBDT, 2012a) and forecasts (DEBDT, 2009) to estimate human population at home and at work (DEBDT, 2012b) by sector. We used tourism authority data to estimate daily visitor counts (HTA, 2012). We used U.S. pet statistics to estimate the population of domestic pets (cats and dogs) on the island of Hawaii (AVMA, 2012). We combined human and pet population data with our spread model infestation rates to compute sting incidents to adults and children at home and at play, adults at work, children at school, and visitors at lodging and at play. Using infestation in the residential sector, we estimated the number of sting incidents to domestic pets in homes.

The number of LFA sting incidents per year $S_{i,t}$ is dependent on the human population $Pop_{i,t}$, the level of infestation, $\frac{N_{i,t}^{establish}}{N_i^{max}}$, and the daily probability of being stung in an infested area $\lambda_{i,t}^{sting}$, multiplied by the number days per year:

$$S_{i,t}^{human} = \lambda_{i,t}^{sting} N_{i,t}^{establish} \left(\frac{N_{i,t}^{establish}}{N_i^{max}} \cdot Pop_{i,t} \right) 365. \qquad (7)$$

Over 35 years, *total human sting incidents* is:

$$Total\ human\ sting\ incidents = \sum_{t=0}^{35} \sum_{i=1}^{7} S_{i,t}^{human}. \qquad (8)$$

Working conditions and land-use characteristics are all used to determine the sting incident rate $\lambda_{i,t}^{sting}$. For example, nursery workers who are in constant contact with plants will typically be stung more frequently than hotel workers. Sting incident frequency increases with the extent of LFA infestation. We quantified LFA sting incidents to humans based on estimated number of human sting incidents that would occur at homes, at work, in parks, at lodging, and at schools. We used population data on residents, work force, and visitors.

The number of pet sting incidents per year is dependent on the number of domestic dogs and cats Pop^{pets}, pet sting incident frequency per day λ^{pets} and level of infestation in the residential (homes) sector:

$$S_t^{pet} = \lambda^{pets} Pop_t^{pets} N_{i,t}^{establish} \left(\frac{N_{i,t}^{establish}}{N_i^{max}} \right) \cdot 365. \qquad (9)$$

LFA human and pet stings are a major social concern. For this study, we enumerate the number of sting incidents without monetizing them to allow the frequency of stings to be considered separately from economic impacts

2.2.2. Management Decisions
Based on level of infestation, management goals and constraints, we use the model to determine investment in prevention, detection, and mitigation by sector and time period. Investment in detection increases the likelihood of finding LFA at newly introduced locations before the infestation becomes established. Investment in prevention reduces the
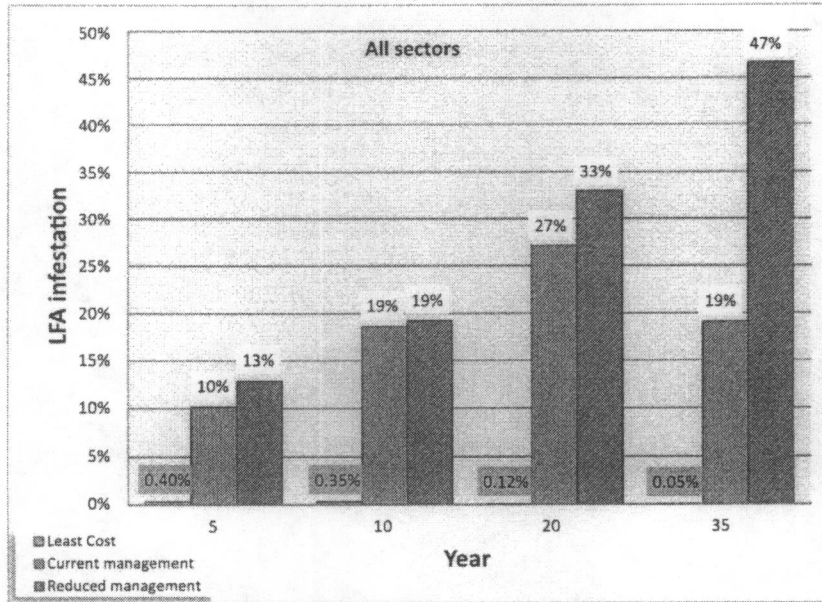
Fig. 2. Little Fire Ant Infestation by management type and year across all sectors.

probability that LFAs are transported between locations. Investment in mitigation reduces the level of infestation at established locations.

2.2.2.1. Decision Variables. The decision (control) variable, $d_{i,t}^{(\cdots)}$, determines the level of effort in prevention, detection, and mitigation in each sector i at each time period t. Prevention and detection activities are non-negative and unbounded, i.e., $d_{i,t}^{prevent}$, $d_{i,t}^{detect} \geq 0$. Mitigation treatment is nonnegative and bounded where $0 \leq d_{i,t}^{mitigate} \leq 4$.

2.2.2.2. Effectiveness. LFAs are elusive and as a result management activities are imperfect. The annual probability that any management activity (prevention, detection, or mitigation) will succeed is less than one. We model management success with a geometric distribution. Where λ is the probability of success (e.g. preventing a new infestation at one location). For $d \leq 1$, the probability of success is $\theta = 0$, for $d \geq 1$, and the probability of success is:

$$\theta = 1 - (1-\lambda)^d \tag{10}$$

where $0 \leq \lambda \leq 1$ and $0 \leq \theta \leq 1$.

Prevention encompasses efforts to thwart new infestations by reducing movement of LFA between locations. Prevention effectiveness $\theta_{i,t}^{prevent}$ depends on the probability of stopping spread $\lambda^{prevent}$ and the investment in prevention $d_{i,t}^{prevent}$:

$$\theta_{i,t}^{prevent} = 1 - \left(1-\lambda_i^{prevent}\right)^{d_{i,t}^{prevent}}. \tag{11}$$

Prevention investment $d^{prevent} \in [0, \infty)$ is in units of person-hours per sector per year and $\lim_{d^{prevent} \to \infty} \left(\theta_{i,t}^{prevent}\right) = 1$.

Monitoring for LFA increases the likelihood that newly introduced LFA colonies are found before they can establish, grow, and spread. Detection effectiveness θ_i^{detect} depends on the probability of detecting an LFA infestation λ^{detect} and investment in detection $d_{i,t}^{detect}$[6]:

$$\theta_{i,t}^{detect} = 1 - \left(1-\lambda_i^{detect}\right)^{d_{i,t}^{detect}}. \tag{12}$$

Detection investment $d_{i,t}^{detect}$ is in units of person-hours per sector per year and $\lim_{d^{detect} \to \infty} \left(\theta_{i,t}^{detect}\right) = 1$.

Mitigation reduces the number of infested locations within a sector. Here mitigation effort is measured in terms of the number of insecticide applications $d_{i,t}^{mitigate}$ per sector per year.[7] Each application eradicates LFA with probability $\lambda_i^{mitigate}$ such that

$$\theta_{i,t}^{mitigate} = 1 - \left(1-\lambda_i^{mitigate}\right)^{d_{i,t}^{mitigate}}$$
$$\text{and} \quad \lim_{d^{mitigate} \to 4} \left(\theta_{i,t}^{mitigate}\right) = \hat{\theta}. \tag{13}$$

Management effort effectiveness parameters are derived from recommended best management practices and expert opinion.

2.2.3. Infested Locations and Spread

The initial infestation $N_{i,0}^{start}$ is set equal to the number of LFA infested (established) locations in 2012 as shown in Table 1. The spread submodel simulates the survival, growth, and dispersal of LFA over time within and between economic sectors. With this pseudo-spatial representation, we simulate LFA spread as occurring with the movement of goods and people over time within and across sectors. With information on acres per unit (location) and units per sector, we estimate infested acreage over time as follows: at each newly infested location the status transitions from "introduced" to either "uninfested" or "incubating[8]" and then to "uninfested" or "incubating" or "established." The model tracks the number of locations N in sector i at time t for each state of infestation $(\cdots)$ *as given by* $N_{i,t}^{(\cdots)}$ a whole number value that cannot exceed the number of locations per sector defined here as: $N_{i,t}^{(\cdots)} \geq 0$ and $\sum_{(\cdots)} N_{i,t}^{(\cdots)} \leq \bar{N}_i^{max}$.

2.2.3.1. Incubation, Detection, Mitigation. During incubation, LFAs reproduce but do not spread. The number of locations with incubating populations equals the number of locations infested from other sectors $N_{i,t}^{introduced}$ plus the number of locations infested internally $N_{i,t-1}^{growth}$. While incubating, LFA can be detected with effectiveness θ^{detect}. The

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[6] This formulation of early detection is a modification of the functional form put forth by Carrasco et al. (2010).

[7] Insecticide application frequency is limited to 4 times per year per the manufacturer's instructions.

[8] Nascent.

number of locations with newly introduced ($w = 1$) incubating infestations that escaped detection is defined:

$$N_{i,t,w}^{incubate(unk)} = \left(N_{i,t}^{introduced} + N_{i,t-1}^{growth}\right)\left(1-\theta_{i,t}^{detect}\right). \qquad (14)$$

The number of newly introduced incubating infestations that have been detected ($w = 1$) is defined:

$$N_{i,t,w}^{incubate} = \left(N_{i,t}^{introduced} + N_{i,t-1}^{growth}\right)\theta_{i,t}^{detect}. \qquad (15)$$

Incubating infestations can be destroyed with probability $\lambda = 1$, so the decision to eradicate is $d = (0, 1)$. If $d_{i,t}^{eradicate} = 1$ then the $N_{i,t,w}^{incubate} = 0$ If $d_{i,t}^{eradicate} = 0$ the number of known locations with incubating populations is defined: Incubating infestations become established after 3 years. The number of locations with established LFA populations is defined:

$$N_{i,t+1,w+1}^{incubate} = N_{i,t,w}^{incubate}\left(1-d_{i,t}^{eradicate}\right) \qquad (16)$$

$$N_{i,t}^{establish} = N_{i,t-1}^{establish} + N_{i,t-1,3}^{incubate} + N_{i,t-1,3}^{incubate\,(unk)}. \qquad (17)$$

All established infestations are assumed to be "known" infestations due to the damages they cause and are thus candidates for mitigation treatment. The effectiveness of treatment $\theta^{mitigate}$ is defined in Eq. (13). The number of locations with established LFA colonies is defined:

$$N_{i,t}^{establish} = N_{i,t-1}^{establish}\left(1-\theta_{i,t}^{mitigate}\right). \qquad (18)$$

The number of infested locations in each sector i is:

$$N_{i,t+1}^{final} = N_{i,t}^{establish} + N_{i,t}^{incubate} + N_{i,t}^{incubate(unk)}. \qquad (19)$$

2.2.3.2. Human Transport. Through human movement (to and from work, school, and outdoor recreation) and goods exchange, live viable ant colonies are dispersed among and between sectors.

Viable ant colonies transported out of one sector to another sector is termed an Outgoing propagule. The number of Outgoing propagules $N_{i,t}^{out}$ is proportionate $\lambda_i^{invasion}$ [9] to the number of infested locations $N_{i,t}^{establish}$ less the effectiveness of prevention efforts $\theta_{i,t}^{prevent}$ and is expressed as follows:

$$N_{i,t}^{out} = N_{i,t}^{establish}\lambda_i^{invasion}\left(1-\theta_{i,t}^{prevent}\right). \qquad (20)$$

Viable ant colonies transported into one sector from other sectors are termed Incoming propagules $N_{i,t}^{in}$. Incoming propagules are the sum of Outgoing propagules $N_{j,t}^{out}$ transported from all other sectors $j \neq i$, defined as follows:

$$N_{i,t}^{in} = \left(\sum_{j}^{n} k_{j,i} \cdot N_{j,t}^{out}\right)\left(1-\frac{N_{i,t}^{growth}}{N_i^{max}}\right). \qquad (21)$$

The matrix K captures the commerce on the island likely to transport ant colonies between sectors. The matrix elements $k_{j,i}$ are nonnegative $0 \leq k_{j,i} \leq 1$ with values that sum to one $\sum_{j}^{n} k_{j,i} = 1$. Uninfested and less infested sectors are assumed more susceptible to incoming propagules than heavily infested sectors hence inclusion of the factor $\left(1-\frac{N_{i,t}^{growth}}{N_i^{max}}\right)$.

Table 2
Little Fire Ant Infestation by sector in years 5 and 35.

Sector	Year 5			Year 35		
	Least cost	Current management	Reduced management	Least cost	Current management	Reduced management
Ag	1%	5%	7%	0.2%	19%	30%
Lodging	5%	50%	54%	0.4%	56%	67%
Nursery	1%	31%	35%	0.2%	43%	56%
Other	1%	8%	9%	0.1%	15%	23%
Parks	0%	60%	60%	0.1%	56%	66%
Residential	0%	11%	15%	0.0%	21%	32%
Schools	24%	52%	64%	0.2%	45%	57%

Percent infested.

Of the incoming propagules only a proportion $\lambda_i^{survive}$ survive to become newly introduced infestations:

$$N_{i,t}^{introduced} = \lambda^{survive}N_{i,t}^{in}. \qquad (22)$$

2.2.3.3. Intrinsic Growth. For our model, we define intrinsic growth as viable ant colonies crawling from one location to another. For LFA, the rate of intrinsic growth λ^{growth} is slow.[10] We simulate intrinsic growth as increasing in the number of established locations $\lambda^{growth}N_{i,t}^{establish}$ and decreasing as the sector approaches full infestation. The number of locations newly infested from intrinsic growth is defined:

$$N_{i,t}^{growth} = \lambda^{growth}N_{i,t}^{establish}\left(1-\frac{N_{i,t}^{establish}}{N_i^{max}}\right). \qquad (23)$$

3. Management Scenarios

To assess the potential economic damages from Little Fire Ant on the island of Hawaii and potential benefits from managing Little Fire Ant, we evaluated a current management (status quo) scenario and two alternate scenarios: reduced management (a reduction in public management efforts to contain infestations and prevent spread) and least cost (a theoretical Pareto optimum that assumes perfect knowledge and full cooperation; the sum of management costs and economic damages is minimized).

Current public management is led by the Hawaii Ant Lab (University of Hawaii). With a staff of five people, the Lab provides research, outreach, education, training, advice and limited mitigation activities for all invasive ant issues in the State of Hawaii including maintaining a website[11] with information on impacts and remedies. The Big Island Invasive Species Committee provides education and outreach on Little Fire Ant and other invasive species on the island of Hawaii.

For the current management scenario, we assumed that residents and businesses with LFA infestations treat periodically to mitigate local impacts but not sufficiently to eradicate LFA from their property or halt the spread to other properties. Treatment occurs when infestation reaches 20%, then control effort is proportionate to the level of infestation. In the Park and School sectors, LFA infestations remain untreated.[12]

For the reduced management scenario, we assumed a cut in public funding for mitigation treatment, prevention, detection, outreach and education which would result in a faster rate of spread. Residents and businesses with LFA infestations treat periodically to mitigate local impacts but not sufficiently to eradicate LFA from their property or halt the spread to other properties. Treatment occurs when infestation

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[9] Termed "base rate invasion probability" (Leung et al., 2002).

[10] Ten meters per year.
[11] www.littlefireants.com.
[12] At present, infested public schools and parks are being treated for LFA. However, when this study began, schools were not treated due to lack of funding and parks were not treated because use of anticides was not permitted.
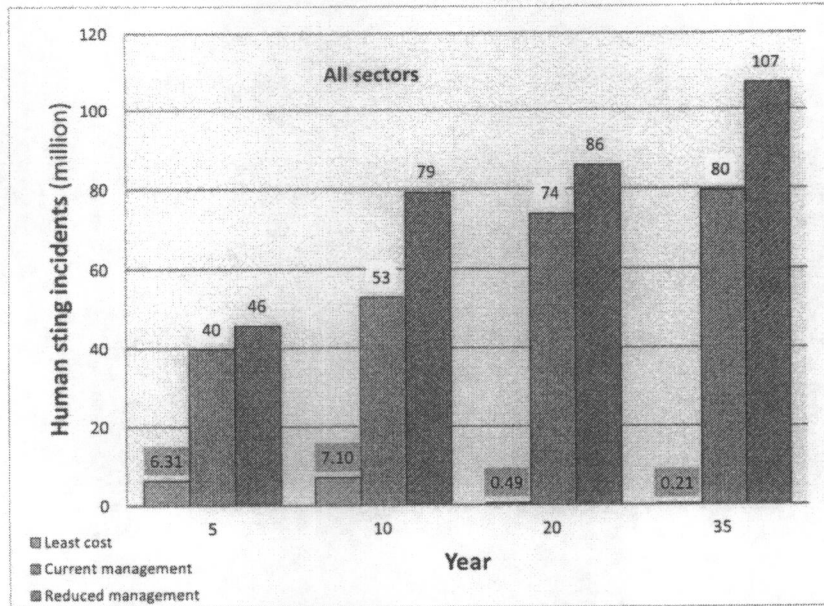
EXHIBIT B

Fig. 3. Little Fire Ant human sting incidents by management type and year across all sectors.

reaches 20%, then control effort is proportional to the level of infestation. In the Park and School sectors, LFA infestations remain untreated.

For the least cost management scenario, we assumed that treatment decisions in all sectors were made to benefit the whole island without regard to distributional effects.

We applied simulation modeling to determine the long-term impacts from current management and reduced management.[13] We applied optimization modeling to determine the cost minimizing decisions and long term impacts from least cost management.

The model was run on Microsoft Excel using the Frontline Risk Solver Platform.

4. Results

4.1. Current Management

Under current management in the coming 5 years, Little Fire Ant will spread on the island of Hawaii infesting 31%, 50%, 60%, and 52% of the nursery, lodging, park, and school sectors. In 10 years, infestation will reach 42% and 54% in the nursery and lodging sectors. In 35 years, the present value total cost from Little Fire Ant is $6.1 billion based on $5.536 billion management expenditures and $549 million in economic damages. Costs are greatest in the agriculture, park, and school sectors. Over 35 years, the total number of Little Fire Ant sting incidents involving children, adults and visitors is 2.3 billion.

4.2. Least Cost Management

To achieve least cost management, Little Fire Ant is suppressed with early mitigation treatment; prevention and detection in all infested sectors. Under least cost management in the coming 5 years, Little Fire Ant infestations decrease to 5% and 24% in the lodging and school sectors, drop to 2.5% in the nursery and lodging sectors, and sink to 1% or lower in the remaining sectors. Over 35 years, the present value total cost is $51 million based on an estimated $40 million in management

expenses and $11 million in damages. Mitigation expenditures are greatest in the agriculture and school sectors. Prevention expenditures are greatest in the residential sector. Detection expenditures are greatest in the lodging sector. Over 35 years, the total number of Little Fire Ant sting incidents involving children, adults and visitors is 94 million.

4.3. Reduced Management

Under reduced management, in the coming 5 years, Little Fire Ant will spread more quickly on the island of Hawaii infesting 53%, 66%, 71%, and 54% of the nursery, lodging, park, and school sectors. In 10 years, infestation will reach 57%, 71%, 74% in the nursery, lodging, and park sectors. Mitigation expenditures are greatest in the agriculture, park, and school sectors. The number of sting incidents is highest in the residential sector. In 35 years, the present value total cost including management expenditures and economic damages from Little Fire Ant is $12.9 billion. Over 35 years, the total number of Little Fire Ant sting incidents involving children, adults and visitors is 2.8 billion.

Simulation model results for infestation over time by sector and management type are illustrated in Fig. 2 and Table 2.

Simulation model results for human sting incidents over time by sector and management type are illustrated in Fig. 3 and Table 3.

Simulation model results for total cost over time by sector and management type are illustrated in Fig. 4a–c.

4.4. Management Tradeoffs

We conducted a multi-objective analysis to evaluate the tradeoff between management focused on reducing the monetary cost of an LFA infestation (management expenditures and damages) versus management focused on reducing the number of human sting incidents. If cost reduction is the primary objective, a least cost management strategy will yield a PV total cost of $51 million and 94 million human sting incidents over 35 years. This outcome is a clear improvement over current management,[14] as both cost and human sting incidents are reduced. This outcome is "efficient" because in order to further reduce

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[13] We applied simulation modeling. For interested readers, a comparable problem solved with constrained optimization would minimize LFA spread subject to a public budget of $200k to depict current management and minimize LFA spread subject to an annual budget of $100k to depict reduced management.

[14] Under current management PV total cost is $6.1 billion and total human sting incidents is 2.3 billion over 35 years.

Table 3
Little Fire Ant human sting incidents by sector in years 5 and 35.

Sector	Year 5			Year 35		
	Least cost	Current management	Reduced management	Least cost	Current management	Reduced management
Ag	0.01	0.03	0.05	0.00	0.26	0.41
Homes	0.00	8.46	11.11	0.00	25.24	38.79
Lodging	0.74	6.79	7.29	0.10	14.33	17.35
Nursery	0.01	0.23	0.39	0.00	0.59	0.76
Other	0.14	1.50	1.76	0.03	4.97	7.81
Parks	0.07	11.27	11.24	0.02	17.80	21.22
Schools	5.34	11.58	14.02	0.06	16.34	20.87

Million sting incidents.

costs, sting incidents would have to rise. If reducing human sting incidents is the primary objective, a least sting management strategy will cost $91 million and reduce human sting incidents to 73 million over 35 years. This outcome is a clear improvement over current management, as both cost and human sting incidents are reduced. This outcome is "efficient" because in order to further reduce sting incidents costs would have to rise. For example, reducing human sting incidents to 22 million will cost $140 million over 35 years for a marginal cost of $3 per human sting incident avoided. Reducing human sting incidents to 6 million will cost $944 million over 35 years for a marginal cost of $306 per human sting incident avoided. Additional numerical results from the multi-objective analysis can be seen in Table 4.

If society places a high value on avoiding sting incidents, i.e. not getting stung, they may be willing to invest more in LFA management and treatment. Information on marginal costs can help individuals determine their preferred level of LFA control. At higher costs, individuals may prefer to be stung rather than pay for the additional management. Efficient alternatives for the island of Hawaii range from $2 to $306 per avoided sting incident. Values are displayed in Table 4 and illustrated in Fig. 5.
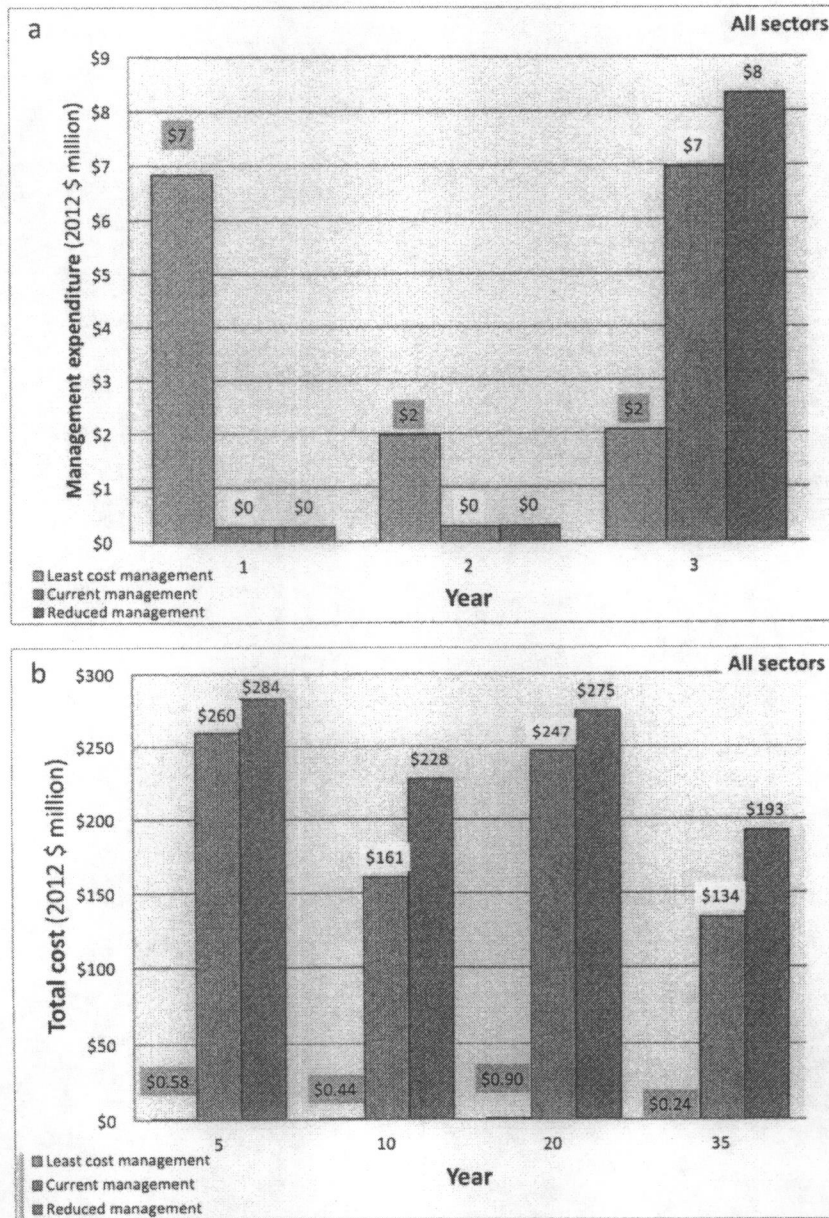
Fig. 4. a. Early management expenditures by year and management type. b. Economic cost to society by year and management type. c. Little Fire Ant total economic cost over 35 years by management type.

C
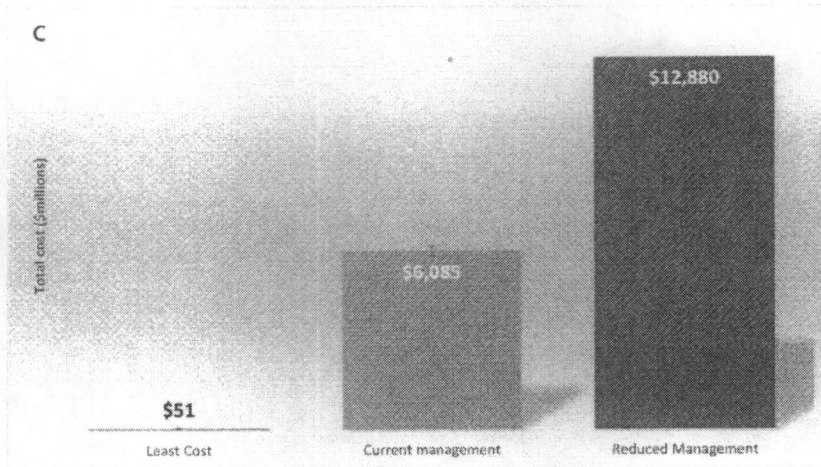
Fig. 4 (continued).

5. Discussion of Results

Our model results showed that an increase in funding over current management will be needed to prevent rapid and widespread infestation of Little Fire Ant on the island of Hawaii.

The benefits from increased management effort include:

- Improved quality of life for residents, children, and pets.
- Savings to homeowners from less frequent treatment of LFA in and around the home.
- Protection to agricultural and nursery farms from large increases in expenses and potential economic losses due to yield decline, treatment costs, lost sales, and reduced export volume.
- Protection to visitor industry businesses from large increases in expenses and potential economic losses due to visitor sting incidents on lodging property and at popular outdoor recreation areas.
- Reduced risk of spread from the island of Hawaii to other islands in the State.

Technical challenges in managing little fire ant on the island of Hawaii include:

- Newly developed bait formulations and application methods are proving effective in controlling LFA populations. However their use in commercial agriculture is banned except for a few food crops.
- LFAs are thriving in beach parks, but until recently no chemical options were permissible for use at infested locations near water.

Economic Challenges and Opportunities

- Treating a widespread infestation of LFA will require a high level of cooperation from all agents including property owners, farms, businesses, and multiple levels of government. In our model, we assumed full cooperation, but in reality that is not be the case. We've heard several complaints from distressed homeowners and farmers about LFA infestations on neighboring properties that are left untreated.
- At the private level, individual households and businesses will pay to control LFA on their own property hence benefiting their neighbors, however since they do not share in those additional benefits, they will then tend to underinvest in LFA control, perhaps not treating the periphery of their property or otherwise leaving more ants than optimal to reproduce and spread (Positive externality).
- The location of new infestations is difficult to predict. To a large extent, the State relies on an observant public to report new infestations —

detection through use of peanut butter sticks, visual observations, or receiving stings (Imperfect information).
- Infested businesses may treat for LFA but be unwilling to report their infestation to avoid repercussions such as loss in customers, ban on sales, lost certification, and quarantine (Asymmetric information).
- Neighborhoods, communities, and businesses within the same industry can share information, treatment methods, and costs, and benefit as a group from managing LFA collectively. Coordinating a group effort requires a lot of communication, time, and willing volunteers (Information costs, scale economies, positive externalities).

6. Conclusions

On the island of Hawaii, Little Fire Ant infests over 4000 locations. Current management includes ant species identification, response, public information and assistance, technology development, public awareness and education. Our findings show that current management is slowing Little Fire Ant spread but will be insufficient in preventing Little Fire Ant from rapidly spreading within the island of Hawaii. Reducing efforts to control Little Fire Ant will lower costs in the short term compared with current management, but lead to more sting incidents,

Table 4
Total cost and total human sting incidents over 35 years.

PV total cost	Human sting incidents	Marginal cost per avoided sting incident[a]
$ mil	mil	$
$51	94	–
$91	73	$2
$140	22	$3
$153	18	$4
$159	17	$5
$166	15	$6
$174	14	$7
$183	13	$9
$194	12	$12
$207	12	$16
$225	11	$24
$254	10	$41
$300	9	$56
$388	8	$83
$944	6	$306

[a] Marginal cost is calculated as Increase in total cost ÷ Reduction in sting incidents from the row above. For example ($91 − 51) ÷ (94 − 73) = $2.
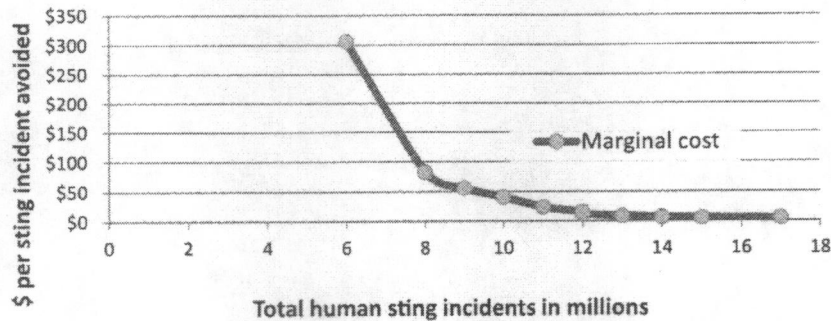
Fig. 5. Marginal cost per avoided human sting incident.

higher costs and larger damages in the longer term. Results indicate that an increase in management effort is economically and socially warranted as the island economy would realize net benefits of $5 billion in total cost savings including a reduction in economic damages of $540 million and avoidance of 2.1 billion human sting incidents over 35 years.

7. Summary

Management effort has a significant impact on Little Fire Ant infestation over time. Under current management, Little Fire Ant infestation will continue to rise in all sectors eventually becoming established in all sectors and in all developed locations on the island in 15 years. By increasing management effort through monitoring, spread prevention, and mitigation, Little Fire Ant spread can be slowed and populations eventually suppressed. Under least cost management, Little Fire Ant infestations are suppressed over the course of 27 years.

Management effort has a significant impact on the number of Little Fire Ant sting incidents. Under current management, people on the island of Hawaii will suffer 2.3 billion sting incidents over 35 years. Their pets will endure 0.9 billion sting incidents over 35 years. With efforts to suppress Little Fire Ant populations, under least cost management during the next 35 years people and pet will suffer fewer sting incidents, down to 94 million for people and 9 million for pets.

Management effort has a significant impact on costs and damages. In the next 35 years the cost of Little Fire Ant under current management will balloon to $6.1 billion. With efforts to suppress Little Fire Ant populations, under least cost management, net costs drop to $51 million, a substantial savings to the local economy.

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EXHIBIT B

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Conservation Council
for Hawai'i

Hawai'i's voice for wildlife

Kō Hawai'i leo no nā holoholona lōhiu

Testimony Submitted to the Senate Committee on Agriculture and Environment
By the Conservation Council for Hawai'i
Hearing: Monday, March 123, 2017 1:15 pm
Room 224

Support for HB 481 HD 1Relating to Invasive Species

Chair Gabbard, Vice Chair Riviere, and Members of the Committee,

Aloha. The Conservation Council for Hawai'i supports HB 481 HD 1, which requires the Department of Agriculture to establish a pilot pesticide treatment coupon project and a little fire ant site map for the county of Hawai'i, requires report to the Legislature on project implementation, and appropriates funds.

This dangerous pest harms humans, and babies are especially vulnerable. The ants also sting and can blind pet dogs and cats. Please consider increasing the proposed allocation of $360,000 in fiscal year 2017-2018 to support programs to prevent the little fire ant from spreading.

➢ Little fire ant infestations are widespread throughout the windward side of Hawai'i Island, including in Hilo, the Puna district, and along the Hamakua Coast, and in and around nurseries and properties that purchased plants from infested nurseries. Smaller infestations have been found in the Kailua Kona area.
➢ On Kaua'i, one infestation is known in the Kalihiwai area.
➢ On O'ahu, it was first detected in December 2013 in a shipment of hapu'u (tree fern) logs from Hawai'i Island. Numerous additional infestations have been found.
➢ On Maui, it was first found in Waihe'e in 2009, then in Nahiku in 2014, and in Huelo and Hana in 2015.
➢ It is not known to be present at this time on Moloka'i, Lana'i, or Kaho'olawe. Let's keep it that way.

Please protect us from the little fire ant and pass HB 481 HD 1. Mahalo nui loa for the opportunity to testify.

Marjorie Ziegler

Marjorie Ziegler

P.O. Box 253, Kunia, Hawai'i 96759
Phone: (808) 848-2074; Fax: (808) 848-1921
e-mail info@hfbf.org; www.hfbf.org

March 13, 2017

HEARING BEFORE THE
SENATE COMMITTEE ON AGRICULTURE AND ENVIRONMENT

TESTIMONY ON HB 481, HD1
RELATING TO INVASIVE SPECIES

Room 224
1:15 PM

Aloha Chair Gabbard, Vice Chair Riviere, and Members of the Committee:

I am Randy Cabral, President of the Hawaii Farm Bureau (HFB). Organized since 1948, the HFB is comprised of 1,900 farm family members statewide, and serves as Hawaii's voice of agriculture to protect, advocate and advance the social, economic and educational interests of our diverse agricultural community.

Hawaii Farm Bureau supports HB 481, HD1, which requires the Department of Agriculture to establish a pilot pesticide treatment coupon project and a little fire ant site map for the county of Hawaii. It also requires report to the Legislature on project implementation.

HFB recognizes the harm that the little fire ant has caused to farms, businesses, and the quality of life of those affected by the pest. We agree that immediate measures must be undertaken to stop its spread to other areas.

Thank you for the opportunity to comment on this measure.

<u>HB481</u>
Submitted on: 3/9/2017
Testimony for AEN on Mar 13, 2017 13:15PM in Conference Room 224

Submitted By	Organization	Testifier Position	Present at Hearing
Carolyn Dillon	Little Fire Ant HUI	Support	No

Comments: Thank you for the opportunity for LIttle Fire Ant HUI to testify in support of HB481. We are a volunteer citizen-led coalition promoting LFA education and training. These vouchers have been an important resource for communities in combating LFA. Our current focus is to expand on LFA treatments by promoting an island-wide Landscape/Arborist LFA Service Provider sector for Hawaii County. We've also reached out to each of the Pest Control Operators on island. Many of them are interested in the LFA training as well. HAL and BIISC are ready to provide the training to these service providers using their existing curriculums. Distributing vouchers to trained professionals would leverage training and vouchers, and would simultaneously address concerns for proper monitoring and verification of those vouchers. Expanding the voucher program to support this new service sector would be a logical and productive step to providing LFA treatments affordably and pervasively. Any and all proactive and aggressive measures we can immediately take to contain and control LFA must be undertaken.

Please note that testimony submitted <u>less than 24 hours prior to the hearing</u>, improperly identified, or directed to the incorrect office, may not be posted online or distributed to the committee prior to the convening of the public hearing.

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HB481

Submitted on: 3/9/2017
Testimony for AEN on Mar 13, 2017 13:15PM in Conference Room 224

Submitted By	Organization	Testifier Position	Present at Hearing
Nancy Redfeather	Hawaii Island School Garden Network	Comments Only	No

Comments: Support is needed now, from the Legislature to move on the current strategies of the Little Fire Ant Hui, a coalition of non-profit, government, and community organizations in West Hawai'i. Mahalo to Representative Lowen for her ongoing support of our work. LFA is the most dangerous foe we have ever encountered, to ecosystems, agriculture, family life and health,animal health, and general quality of life. We need support for materials and mapping to continue our work at a high level on Hawaii Island. Mahalo for your support for the future of Hawaii's communities and food systems.

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March 13, 2017

Testimony To: Senate Committee on Agriculture and Environment
                 Senator Mike Gabbard, Chair

Presented By: Tim Lyons, CAE
                 Executive Director

Subject: H.B. 481, HD 1 - Relating to Invasive Species

Chair Gabbard and Members of the Committee:

I am Tim Lyons, Executive Director of the Hawaii Pest Control Association.

We support this bill. Private pest control operators are trained routinely on ant control, their biology and the better methods of control. As an example, the little fire ant typically harbors in trees and bushes up as much as six (6) feet high. Not every homeowner will want to climb a ladder and make an outdoor pesticide application.

We support this appropriation which will help to reduce the homeowner's cost. We also think that a map indicating infestation sites would be helpful.

Based on the above, we support this bill.

Thank you.

Sarah Worth
Co-Chair of the Natural Resource Management Sub-Committee

March 10, 2017

Senator Mike Gabbard, Chair
Senator Gil Riviere, Vice Chair
Committee on Agriculture and Environment
HB 481 HD1
RELATING TO INVASIVE SPECIES
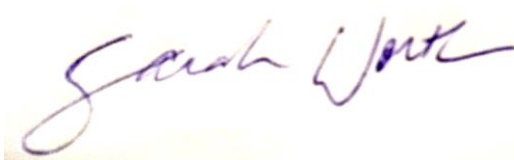March 13, 2017   1:15 pm   State Capitol, Conference Room 224

Submitted on Behalf of the Environmental Caucus of the Democratic Party of Hawai'i

The Environmental Caucus of the Democratic Party of Hawai'i strongly supports the intent of HB 481 HD1 "Relating to Invasive Species" in regard to establishing a pilot pesticide treatment coupon project and a little fire site map for the county of Hawai'i, requiring a report on the program's implementation, and appropriating funds.

Addressing invasive species, especially little fire ants, which have a devastating impact on our agriculture, wildlife, and quality of life is one of the legislative priorities of the Environmental Caucus of the Democratic Party of Hawai'i for the 2017 Legislative Session.

Mahalo for the opportunity to comment on this bill.

Respectfully submitted,

/s/ Sarah Worth   (sarahkworth@yahoo.com)
Member of the Natural Resource Management Sub-Committee

The Environmental Caucus of the Democratic Party of Hawaii hopes that you will join us in securing an environmentally sustainable future for Hawai'i and its Ohana.
627 South Street Honolulu, HI 96813
website: hawaiigreencaucus.org email: ecodemhi@gmail.com

HB481

Submitted on: 3/10/2017
Testimony for AEN on Mar 13, 2017 13:15PM in Conference Room 224

Submitted By	Organization	Testifier Position	Present at Hearing
Javier Mendez-Alvarez	Individual	Support	No

Comments:

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From the office of –
Council Member
District 3
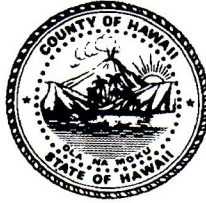
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SUSAN L.K. LEE LOY
25 Aupuni Street, Hilo, Hawaiʻi 96720

The Honorable Mike Gabbard, Chair
And members of the Committee on Agriculture and Environment
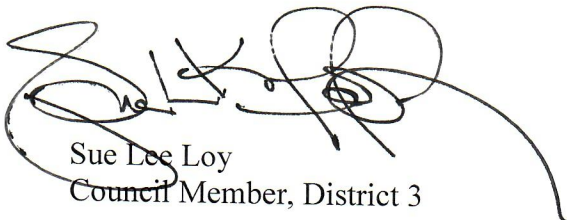
March 10, 2017

Dear Chair Gabbard and Honorable Committee Members,

Thank you for the opportunity to provide testimony in strong support of House Bill 481, HD1. My colleagues on the Hawaiʻi County Council on February 22, 2017, have approved a resolution in full support of this bill and its companion.

The pilot pesticide treatment coupon project is a welcome effort that will slow the spread of this disastrous invasive species. The cost of pesticide is a significant obstacle to the ability of Hawaiʻi Island families to treat their properties, thus allowing Little Fire Ant infestations to continue to grow and increase in density. A pilot pesticide treatment coupon project will provide the Department of Agriculture information on new strategies to fight the ant and document its spread while at the same time helping residents and agriculture sector workers deal with this costly and painful infestation.

On behalf of the residents of Hawaiʻi County, I ask for your support.

Aloha Piha,

Sue Lee Loy
Council Member, District 3

HB481

Submitted on: 3/11/2017
Testimony for AEN on Mar 13, 2017 13:15PM in Conference Room 224

Submitted By	Organization	Testifier Position	Present at Hearing
Audrey Tamashiro-Kamii	Individual	Support	No

Comments:

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