Linepithema humile (Mayr)

Other Latin names : Iridomyrmex humilis

Common name(s) : Argentine ant

Linepithema humile (Mayr) is a member of the family Formicidae, subfamily Dolichoderinae. Workers of this species are small, medium to dark brown ants, reaching 2 to 3 mm in length. Body surface is smooth and shiny, and lacks erect hairs on the dorsum of the head and thorax. The petiole is composed of a single, scale-like segment, and sting is absent. Workers are extremely fast moving and industrious, often recruiting in high numbers.

Holldobler, Bert, and Edward O. Wilson. 1990. The ants. The Belknap Press of harvard University Press, Cambridge, Massachusetts. 732 pp. illus. (ISBN: 0-674-04075-9; Library of Congress: QL568.F7H57 1990)

Native to where : Argentina and parts of Brazil (Tsutsui and Case 2001)

Biology and ecology : As a typical "tramp" ant, Linepithema humile easily disperses around the world through commerce and other human-assisted avenues. It generally thrives in, although is not limited to, disturbed or modified habitat such as agricultural land and urban environments. Its competitive success stems from its unicolonial social structure: highly reduced intraspecific aggression leads to the formation of large, continuous supercolonies that dominate competitors or prey through numerical superiority (Human and Gordon 1996, Holway 1999). Unlike most ant species, Argentine ant queens do not participate in a nuptial flight but instead disperse locally by budding, thereby slowly expanding the supercolony. When established in optimal habitat, this species usually excludes most other ants and can heavily impact non-ant arthropods as well (Holway et al. 2002).

Recent work has shown that Linepithema humile does not completely dominate the local ant fauna in its native range, but instead coexists with numerous ant species. This appears to result at least in part from elevated intraspecific aggression between colonies, relative to that seen in most introduced colonies (Holway et al. 1998, Suarez et al. 1999).

Value to humans : No commercial value

Problems caused : In contrast to continental areas where the Argentine ant has become established, Hawaiian arthropods evolved without the selection pressures associated with ant presence. There are no native ants or other social insects (Wilson 1996), and native arthropods are often soft-bodied, flightless and vulnerable to ant predation (Reimer 1994). Able to survive at elevations above 2000 m, the Argentine ant is one of the few introduced ant species that can invade native sub-alpine ecosystems in Hawaii. Although it can be found down to elevations below 900 m, it is a particular threat in high elevation areas where the majority of unaltered native habitat remains.

In Haleakala National Park the ant has established two unicolonial populations above 2000 m. A comparative survey conducted within and outside ant-infested areas of the park revealed that the Argentine ant is impacting a wide range of native arthropods, including some native plant pollinators (Cole et. al. 1992). The effects of the ant appear to be more detrimental at higher elevations, where endemic arthropods make up a larger proportion of the fauna and are often naturally rare. At high elevations on Mauna Kea (Wetterer et al. 1998), the Argentine ant overlaps its range with the endangered Palila, a large Hawaiian honeycreeper. The ant could disrupt nesting behavior and may limit the areas to which it can be successfully re-introduced.

The Argentine ant is a pest species for various reasons. In those areas where the ant infests agriculture, as in California and Florida, crops can be negatively affected due to the ant's habit of tending pest Homopterans, such as Oleander aphids (Bristow 1991), citrus mealybug, citrus aphids, brown soft scale, black scale and cottony-cushion scale (Markin 1970b). The ants cause additional direct and indirect damage to crops by reducing predators of insect pests and feeding on the fruits and buds of citrus trees. In South Africa, they hinder beekeeping ventures by preying upon both immature and adult bees, stealing honey and competing for nectar resources (Buys 1990).

Where it invades natural areas, the Argentine ant typically preys upon or displaces native ants (Donnelly and Giliomee 1985, Ward 1987, Majer 1994, Human and Gordon 1996, Way et al. 1997, Suarez et al. 1998), and in some cases non-ant arthropods as well (e.g. Gambino 1990, Cole et al. 1992, Human and Gordon 1997). On the U.S. mainland, it has displaced native ants in Alabama, Louisiana and California (Newell 1908; Erickson 1972; Ward 1987). The Argentine ant has even displaced other "tramp" ant species, as in Bermuda where Pheidole megacephala was usurped in some areas (Crowell 1968; Haskins and Haskins 1965) and in Alabama where Solenopsis richteri was dislocated (Wilson, 1951). As a result of native ant displacement, plants that depend on native insects for pollination and seed dispersal can be impacted, as demonstrated in South Africa (Bond and Slingsby 1984, Christian 2001). In some cases vertebrates may be affected either directly or indirectly (Newell and Barber 1913, Suarez and Case 2002, Holway et al. 2002).

Invasive attributes : (See elsewhere in this document, particularly the "Problems" section.)

Ecosystem attribs : Native to South America, the Argentine ant has now become established on all continents except Antarctica, as well as a number of oceanic islands (Suarez et al. 2001). It predominantly occurs in areas between 30 and 36 degrees latitude (north and south), as well as higher elevations in more tropical locales. Capable of invading disturbed urban and agricultural habitat, as well as natural areas. A major limitation to population expansion appears to be insufficient moisture in arid regions (Ward 1987; Majer 1994; Holway 1995, Holway et al. 2002) and cold temperatures and possibly excessive moisture and in more temperate or humid areas (Reimer, 1994; Krushelnycky, unpubl. data).

Local history : During the 1930s, this species was frequently intercepted in Honolulu in goods shipped from California. Establishment was first recorded in the Ft. Shafter area of Honolulu in 1940 (Zimmerman 1941). While it soon became fairly widespread on Oahu, it now apparently no longer occurs on this relatively low island (maximum elevation approximately 1220 m). The Argentine ant may therefore have been extirpated from suitable habitat on Oahu, possibly outcompeted by Pheidole megacephala. It reached the island of Maui at Makawao by 1950 (Wilson and Taylor 1967), and Haleakala National Park by 1967 (Huddleston and Fluker 1968). The date at which the Argentine ant reached The Big Island of Hawaii is unknown, but it presently occurs in several areas, including Hawaii Volcanoes

National Park and on Mauna Kea. The ant can also be found in the Kokee State Park area of Kauai.

The Argentine ant has been studied most intensively in Hawaii by the Biological Resources Division of the USGS at Haleakala National Park on Maui. Studies have investigated effects on the shrubland and aeolian zone arthropod fauna (Cole et al. 1992) as well as on the endangered Ua'u, or Hawaiian Dark-rumped Petrel (Krushelnycky et al. 2001). The latter study determined that the Argentine ant does not appear to impact the Ua'u, most likely because cold temperatures in the seabird's high elevation burrows discourage ant foraging. In addition, rates and patterns of spread of the two Argentine ant populations in the park have been monitored periodically for over 20 years, and foraging behavior has been studied (unpublished data).

The main focus of the Argentine ant project at Haleakala, however, has been to develop a technique to eradicate the two unicolonial populations. As biological control is not considered feasible, the program has studied toxicants as a possible method for control. One of the first priorities was to find an attractive bait carrier for the toxicant. Bait preference tests have been conducted for the Argentine ant in the lab and in citrus groves in California, and this species has often been found to prefer sugar water over all other baits (Baker et al. 1985, Gaston and Baker 1984). Additionally, Forschler and Evans (1994) found that the commercially formulated Maxforce, hydramethylnon toxicant in a silkworm high-protein bait, was attractive to and effective against the Argentine ant in urban situations in Georgia. Because the sites of infestation in Haleakala National Park consist largely of undisturbed natural areas, however, regular food sources are less predictable. From 1994 to 1995, eight baits were tested at each of two Haleakala sites for attractiveness, with feasibility for large-scale control as an important criterion. At both sites, the bait carrier for Maxforce, a silkworm protein-based bait developed by the Clorox Corporation, appeared to be more popular than any other solid bait. Sugar water was also found to be highly attractive, but was not judged to be practical for large-scale dispersal (Krushelnycky and Reimer 1998a).

Subsequently, the efficacy of commercial Maxforce was investigated in field test plots (Krushelnycky and Reimer 1998b). Various applications of Maxforce were tried, but Maxforce granules broadcast at 2 and 4 lbs/acre were the focus of the study. Foraging ant numbers at monitoring bait stations were greatly reduced, but eradication was not achieved in any of the treated plots. A nest survey indicated that while many nests retrieved the bait, not all of them were killed. Bait attractiveness and a small window of foraging opportunity were judged to be the main obstacles in achieving eradication.

As no technique for eradication is currently available at Haleakala, USGS has refocused its efforts on slowing or preventing further spread of the two ant populations. In 1996, an experimental plot was established along the leading edge of the lower ant population, and was treated with Maxforce granular bait. This 120 m wide plot tested the effectiveness of a single annual treatment for halting outward dispersal. The experimental plot was successful in preventing spread for at least one year (Krushelnycky et al.

2004), and based on these results a 120 m wide perimeter treatment has been carried out for all expanding borders of both populations once annually since 1997. This annual border treatment has met with varying success over both time and space, but overall has slowed the ant's rate of spread (W. Haines unpublished data). The goal of this program is to temporarily buy time as eradication techniques are further researched.

Control strategies : Much research has been directed at developing chemicals for control and/or eradication of the Argentine ant, mostly because of its pest status for homeowners and cropgrowers. Efforts have focused mainly on insecticides, including growth hormone analogues, although semiochemicals have also been investigated as potential repellants (Shorey et al. 1992). At this point, biocontrol is not regarded as an option.

The history of Argentine ant control efforts is a long one. Although the ant was first seen in the U.S. in New Orleans in about 1891 (Newell 1908), it wasn't until it appeared in California in 1907 that action was proposed. Its potential threat to the California citrus industry was first suggested by the University of California in 1908 (Haney 1984). Soon after, as early as 1913, control efforts involving pine tar bands around tree trunks, moats around trees, and trap boxes were implemented in citrus groves. Later, managers began fumigating with carbon bisulfides, hydrogen cyanide gas, pyrethrum powder and arsenic syrup (Haney 1984).

As newer chemicals became available later in the century, control efforts were renewed, often on a larger scale. In 1972 granular Chlordane was being applied at 100 lbs/acre over larger areas (Haney 1984), but this technique was discontinued after Chlordane was outlawed in 1979. The insecticide Diazinon was still available, although one recommended method of delivery - application of granules directly to nests - was not very practical or cost effective. Haney (1984) used liquid Diazanon and liquid Lorsban as a spray around the base of trees and found that this method controlled 97% of the supercolony in a citrus grove.

While research in California focused on control in citrus and other agriculture, pest managers in Australia were focusing on eradicating or controlling the ant in urban areas as well. The ant was first recorded in Victoria in 1939, Western Australia in 1941, and New South Wales in 1950 (Jenkins and Forte 1973). In 1945 DDT was first used as a barrier spray for houses and orchards, and in 1950 an effort was undertaken to eradicate the ant from the city of Fremantle using a blanket spray of DDT. In 1954 the Argentine Ant Act was passed, a campaign headed by the Department of Agriculture and designed to eradicate or control the ant in large urban and rural areas (Jenkins and Forte 1973). Subsequently 31,000 ha of Argentine ant-infested territory were sprayed with DDT, chlordane, dieldrin and later heptachlor (van Schagen et al. 1994). It was reported that the Argentine ant was "successfully eradicated from most of this area" (van Schagen et al. 1994). In 1962, the New South Wales Government passed the Argentine Ant Eradication Act with the specific objective of removing the ant from Sydney and Wollongong using chlordane (Pasfield 1968). None of these campaigns were completely successful in achieving eradication, but did reduce ant numbers. All of these chemicals were eventually outlawed, with heptachlor being banned in 1988 (van Schagen et al. 1994). Whitehouse (1988) provides additional information on control efforts in Australia.

More recently, several other classes of chemicals have been studied for potential efficacy against pest ants. Edwards (1986) tested the insect juvenile hormone analogue methoprene on several species. While he found it to be very effective against the pharaoh ant (Monomorium pharaonis), it was apparently ineffective against Argentine ants because of their inconsistent bait preferences (Edwards 1986). Shorey et al. (1992) used semiochemicals and related pheremones to disrupt foraging behavior in Argentine ants, and found the chemical farnesol to be the most effective. This type of control, however, is only useful for excluding foraging workers from specific target areas, such as citrus trees. In contrast, the toxicant hydramethylnon has been incorporated into several granular baits that are attractive to ants and can be easily broadcast over larger areas. This metabolic inhibitor also has the advantage of acting relatively slowly, potentially allowing more complete distribution of the bait before high mortality begins. Another toxicant, fipronil, is effective in very small quantities and may also achieve delayed mortality. Efforts to eradicate the Argentine ant in natural areas in Hawaii have focused on trying to fine-tune the right combination of attractive bait, slow-acting toxicant, and effective method of application.

Miscellaneous notes : Line drawings of the Argentine ant can be found in Wilson and Taylor (1967) and Holldobler and Wilson (1990) (believed to be the same drawing; both listed as Iridomyrmex humilis, as both were published before the revision by Shattuck [1992]).

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Relevant websites : California Academy of Science's AntWeb:
http://www.antweb.org/description.do?rank=species&genus=linepithema&name=humile&project=calants

New Zealand's Landcare Research:
http://www.landcareresearch.co.nz/research/biosecurity/stowaways/key/linhum.asp

AMNH Social Insects Web:
http://atbi.biosci.ohio-state.edu:8880/hymenoptera/nomenclator.name_entry?text_entry=linepithema+humile&Submit=Submit+Query

Terry McGlynn's Non-Native Ants page:
http://home.sandiego.

du/~tmcglynn/exotic/species/Linepithema_humile/Linepithema_humile.htm

IUCN/ISSG's Global Invasive Species Database:
http://www.issg.org/database/species/ecology.asp?si=127&fr=1&sts=sss

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