Dominant Ant Species in Four Habitats in Hawaii (Hymenoptera: Formicidae)

by

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ABSTRACT

The Hawaiian Islands represent one of the few ecosystems in the world that lacks native ants and thus represents a unique environment in which to study invasion biology. In the course of a study of behavioral interactions among invasive ant species, we collected the most abundant ants from four different field sites on the islands of Oahu and Hawaii. One year after the original collections, we returned to these sites and again surveyed the dominate ant fauna. We hypothesized that the species showing highest levels of aggression in laboratory assays would continue to be most abundant at their respective collection sites; and this proved to be the case at three of the four locations. *Pheidole megacephala*, *Linepithema humile*, and *Wasmannia auropunctata* were each most abundant in both 2005 and 2006 at their respective collection sites, while *Technomyrmex albipes* was more common in the second year than *Anoplolepis gracilipes* (the major species collected a year earlier) at the fourth location.

Key Words: *Pheidole megacephala, Linepithema humile, Wasmannia auropunctata*, dominant ants, Hawaii, dominance related to aggression

INTRODUCTION

The Hawaiian Islands represent one of the few ecosystems in the world that lack native ants (Wilson and Taylor 1967, Reimer *et al*. 1990). Approximately 45 ant species have invaded Hawaii, and about half of these are prominent in urban, agricultural and natural environments (Reimer 1994, Krushelnycky 2005). Since ant assemblages in Hawaii are all synthetic, it is a unique and interesting environment in which to study invasion biology with respect to establishment, ecological interactions, and impacts.

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In the present study, we explored the parallels between aggressive behavior in agonistic laboratory assays and abundance and dominance in the field. The four sites selected for field surveys are the same locations where we previously collected ant species for laboratory bioassays to examine interspecific behavioral interactions (Kirschenbaum 2007, Kirschenbaum & Grace 2007). These field sites are Waimanalo and Tantalus on the Island of Oahu, and Papaiko and Puu Huluhulu on the Island of Hawaii. We hypothesized that the species with highest levels of aggression would continue to be the most abundant at each of the collection sites.

To summarize our laboratory agonism assays (Kirschenbaum 2007): we performed two sets of bioassays. In the first experiment, we assessed agonistic interactions of five ant species collected from either Waimanalo or Tantalus (Oahu): *Leptogenys falcigera* Roger, *Camponotus variegatus* Smith, *Anoplolepis gracilipes* Smith, *Ochetellus glaber* (Mayr), and *Pheidole megacephala* (Fabricius). In both individual and group assays, *P. megacephala* and *A. gracilipes* were the most agonistic species.

In the second laboratory experiment, we used four species, *P. megacephala*, *A. gracilipes, Linepithema humile* (Mayr), and *Wasmannia auropunctata* Roger, considered to be dominant species in Hawaii (Reimer *et al.* 1990, Reimer 1994, Krushelnycky 2005) and collected from Waimanalo, Tantalus, Papaiko, or Puu Huluhulu. *Pheidole megacephala* and *L. humile* were ranked as the most aggressive in individual assays. These two species showed the most defensive behavior when paired with *W. auropunctata*, and suffered high mortality in group assays when paired against *W. auropunctata*. *Wasmannia auropunctata* appeared to be the species with the highest overall level of agonism when both individual and group assays were considered.

The results from these series of agonistic laboratory assays (Kirschenbaum 2007) indicated that the following species were most aggressive, and therefore likely to be the most abundant species at their respective field locations: *P. megacephala* at Waimanalo, *A. gracilipes* at Tantalus, *L. humile* at Puu Huluhulu, and *W. auropunctata* at Papaiko. One year after the initial ant collections and bioassays, a second field survey was performed at these sites.

METHODS AND MATERIALS

The two collection sites on the Island of Oahu differ slightly in elevation and temperature. Tantalus is 634 m above sea level with an average yearly rainfall of 2662.5 mm. The other site at the Waimanalo Research Station is 18 m above sea level, with an average yearly rainfall of 1107.6 mm and an average temperature of 23.8 degrees Celsius. On the Island of Hawaii, Puu Huluhulu is in a national park representing a "kipuka," or raised vegetated area surrounded by a younger lava flow. Papaiko is a small town outside of the town of Hilo on the Island of Hawaii. The collection site was a small fruit orchard with mangosteen and rambutan trees.

Two hours were spent surveying each site. Baits (considered as site subsamples) consisting of Starkist brand tuna in oil, Jiffy peanut butter, and Walkers shortbread cookies were randomly placed on the ground or on tree trunks to sample the ant fauna throughout each site. The subsamples were checked every five minutes for the first hour and every twenty minutes for the second hour. All ant species were identified and photos were taken at every interval for accurate counts of individuals.

RESULTS AND DISCUSSION

The results of the field survey were in agreement with our hypothesis at Waimanalo, Puu Huluhulu, and Papaiko, but not at Tantalus. *Pheidole megacephala* was the most abundant species at Waimanalo with 6,529 individuals (Table 1). The other species present at Waimanalo were *O. glaber* with 986 individuals and *Plagiolepis alluaudi* Emery with 556 individuals. *Linepithema humile* was the only species present at the baits in Puu Huluhulu with 370 individuals. *Wasmannia auropunctata* was the only species at the Papaiko site, with the highest recorded number of individuals (13,467) of all the species at all sites.

Although *Anoplolepis gracilipes* was the dominant species collected in 2005 at Tantalus, *Technomyrmex albipes* (Fr. Smith) was the most abundant species one year later (Table 2). *Anoplolepis gracilipes* had the lowest abundance (15 individuals) compared to all species at all sites (Table 1). Although this species showed high levels of agonism in our earlier laboratory assays, it was

Table 1. Ant species and abundance at four locations on the Islands of Oahu and Hawaii in 2006.

Waimanalo (Oahu)	
Species	Total present
Pheidole megacephala	6,529
Plagiolepis alluaudi	556
Ochetellus glaber	986
Tantalus (Oahu)	
Species	Total present
Anoplolepis gracilipes	15
Technomyrmex albipes	256
Puu Huluhulu (Hawaii)	
Species	Total Present
Linepithema humile	370
Papaiko (Hawaii)	
Species	Total present
Wasmannia auropunctata	13,467

Table 2. Ant species collected at each field site in 2005, and the species present on baits approximately 1 year later (2006).

Waimanalo	**2005**	**2006**
Pheidole megacephala	X	X
Plagiolepis alluaudi		X
Ochetellus glaber	X	X
Camponotus variegatus	X	
Leptogenys falcigera	X	
Tantalus		
Anoplolepis gracilipes	X	X
Technomyrmex albipes		X
Puu Huluhulu		
Linepithema humile	X	X
Papaiko		
Wasmannia auropunctata	X	X

less aggressive than *P. megacephala*, *L. humile* and *W. auropunctata*. Thus, *A. gracilipes* may have been more readily displaced than these other species. Although not examined in this study, it is also possible that certain species may have been more readily recruited to the bait materials employed than other species.

Our survey indicated a change in the ant fauna at Waimanalo and Tantalus over the period of ca. one year since our previous collections (Table 2). For example, we did not observe any foraging workers of *P. alluaudi* in 2005, but in 2006 it was one of the three species attracted to baits at Waimanalo. The same is true at Tantalus in that *T. albipes* was not previously observed, but was recorded as the most abundant species present at baits in the current survey. Although agonistic assays provide a generally realistic reflection of ant species dominance in the field, community composition certainly may change over time. Colony size, occurrence of preferred microhabitats and specific foraging preferences are other factors affecting ant community composition that are difficult to dissect in behavioral assays alone.

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