RANGE EXPANSION AND LOCAL POPULATION INCREASE OF THE EXOTIC ANT, *PHEIDOLE OBSCURITHORAX*, IN THE SOUTHEASTERN UNITED STATES (HYMENOPTERA: FORMICIDAE)

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ABSTRACT

The exotic ant, *Pheidole obscurithorax* Naves, is currently expanding its range and increasing in local density in the southeastern United States. We describe new county records from 5 states and local density increases along roadside transects in the Tallahassee, Florida area. The patchy distribution suggests that this species is being transported to new localities by people. Throughout its introduced range, this species is largely confined to highly disturbed habitats, such as lawns and roadsides and frequently co-occurs with the introduced fire ant, *Solenopsis invicta* Buren. Locally, although the maximum density of nests per unit area has not changed since 2002, the total area occupied, and the total number of nests of *P. obscurithorax* is much greater. Beyond these data, little is known of the biology of this species.

Key Words: abundance, Florida, invasive species, roadsides

RESUMEN

La hormiga exótica, *Pheidole obscurithorax* Naves, actualmente esta expandiendo su rango y localmente aumentando su densidad en el sureste de los Estados Unidos. Nuevos registros para condados en 5 estados del pais y el aumento de la densidad local a lo largo de los caminos que cruzan el área de Tallahassee, Florida son descritos. Su distribución irregular indica que esta especie esta siendo transportada a nuevas localidades por medio de gente. A travéz de su rango de introdución, esta especie es usualmente limitada a áreas muy disturbadas, como los cespedes y lo largo de los caminos y se encuentra a menudo junta con la hormiga de fuego introducida, *Solenopsis invicta* Buren. En cuanto de su distribución local, aunque la densidad maxima de los nidos por unidad de área no ha cambiado desde el año 2002, la área total ocupada y el número total de nidos de *P. obscurithorax* es mucho mayor. Mas alla de estos datos, poco es conocido sobre la biologia de este especie.

The southeastern United States, particularly Florida, is a global hot spot for biological invasion. Among the invaders, there is a very large and growing number of exotic ant species (Deyrup et al. 2000; Deyrup 2003). The most conspicuous members of this exotic ant fauna were transported from the South American region that spans northern Argentina, Paraguay, and southern Brazil in the vicinity of the Paraguay, La Plata, and Parana Rivers. The best-known members of this group include the imported fire ants *Solenopsis invicta* Buren and *S. richteri* Forel, and the Argentine ant *Linepithema humile* (Mayr), all of which have achieved pest status. The notoriety of these species is a direct result of their pest status and now global distribution, although they may also pose a threat to some native flora and fauna (Holway et al. 2002; Tschinkel 2006). There have been a number of non-pest ant species from this same South American region that were probably first introduced and established in the Mobile, Alabama area which may be following a similar spread trajectory as the pest species. These species may have the potential to become pests or negatively impact native species if their populations continue to grow and spread.

Storz & Tschinkel (2004) first documented the recent spread and ecological associations of one such species, *Pheidole obscurithorax* Naves. *Pheidole obscurithorax* was probably first introduced in Mobile, Alabama around 1950 (Naves 1985) and has subsequently slowly spread across the panhandle of Florida (Wilson 2003; Storz & Tschinkel 2004), appearing in the Tallahassee, Florida area in the late 1990s. This is an unusually large and active species of *Pheidole* that attracts the attention of entomologists, so its spread has not gone unnoticed. Field characters are large size (about twice the size of the common native species, *Pheidole dentata*), large nest mounds, usually with a single entrance, and spectacularly fast recruitment to bait such as cookie crumbs. More recently, *P. obscurithorax* has expanded its range and become much more abundant. Although this species is not currently a pest species, it is an abundant invasive exotic about which we know very little. We can presently make few predictions about its current or long-term impact and range limits. Because it overlaps in distribution with fire ants and is closely associated with humans it warrants careful monitoring. Moreover, we already know that one species of *Pheidole*, *P. megacephala*, has had deleterious effects on certain natural ecosystems (Hoffmann et al. 1999). Here we update the distribution of *P. obscurithorax* in the southeastern U.S. and show that it is greatly increasing in local abundance.

MATERIALS AND METHODS

We gathered new records from both taxonomists (Lloyd Davis, Mark Deyrup, Joe MacGown) working in the southern United States and our own collections to estimate the introduced range of *P. obscurithorax*. We used county records as estimates for our distribution map (Fig. 1) because this species now covers such a large area and there has not been a comprehensive effort to document its full range.

For our local density study, we resampled the same localities in Tallahassee, Florida that were sampled by Storz & Tschinkel (2004). Storz & Tschinkel (2004) counted nests along one 50 × 1-m transect located along roadsides scattered throughout Tallahassee. To increase the area of observation, and thus get a more representative sample, we sampled in the same localities as Storz & Tschinkel (2004) but quadrupled (two 100 × 2-m transects per locality) the length of transects. We then calculated the average number of nests in a 50 × 1-m transect area (total number of nests divided by 4) for comparison with Storz & Tschinkel (2004). This average value was used to create accumulation curves (Fig. 4) of nest density per 50 × 1 m with the program Ecosim (Gotelli & Entsminger 2001).

RESULTS

New records indicate that since 2002, *P. obscurithorax* has spread to 16 new counties in 5 states, including a record from Texas (Fig. 1). This pattern of spread suggests that, in addition to spreading locally by natural dispersal of winged females, long-distance dispersal is almost certainly facilitated by human transport. Generally, throughout its range this species is closely associated with the most disturbed sites such as lawns and roadsides, although there have been a few records in natural areas such as hardwood forests (Wilson 2003). We also have collected this species in pastures. The most commonly co-occurring conspicuous species in the Southeast are *Dorymyrmex bureni* (Trager) and *S. invicta*. We have observed nests of all 3 species within a meter or less of one another.

In 2006, nests of *P. obscurithorax* were present at all sites and all but one 100-m transect. The number of nests per transect ranged from 0 to 22, and averaged about 7 nests. The frequency distribution (Fig. 2) was right-skewed, with maximum values about 3 times the mean. This might be the pattern expected for an invasion in progress, and if that were the case, sites that have been occupied longer would be expected to host more nests. For 2006, sites that were first occupied in 1999 hosted an average of 4.4 colonies; those first occupied in 2002 had 5.1 colonies and those in 2006, 2.2 colonies. These differences were not significant (ANOVA: adjusted $R^2 = 0.101$; $P < 0.081$), and fail to support an effect of time-occupied on nest density.

Although we sampled the same sites in 2006 as did Storz & Tschinkel (2004) in 1999, 2000, and 2002, we sampled an average of almost 4 times as much area. Thus, we cannot directly compare the numbers of nests found in each transect and site.

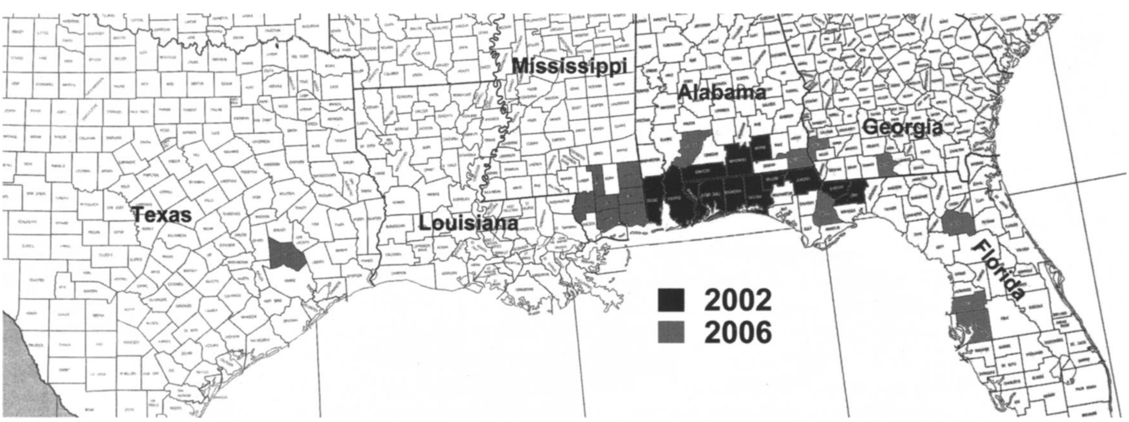

Fig. 1. The increase in range, by county, of *Pheidole obscurithorax* in the southeastern United States, 2002 to 2006.

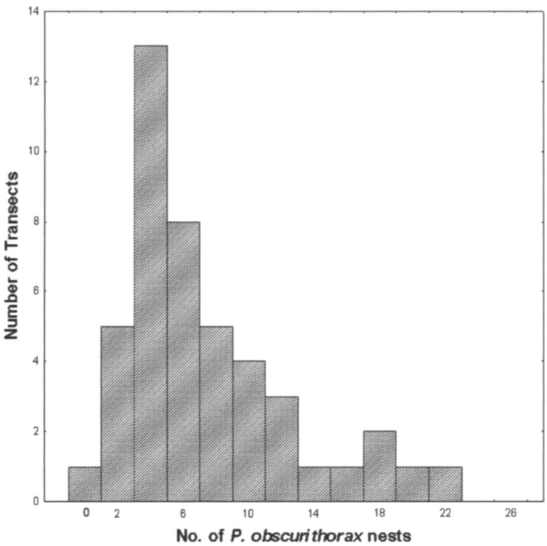

Fig. 2. Frequency distribution of number of *P. obscurithorax* nests on 100-m transects in 2006.

Converting these data to densities (nests/m^2) allows the comparison presented in Fig. 3. Although the maximum densities for 2000 and later were not very different, the number and proportion of sites from which *P. obscurithorax* was absent were different. In 1999, 71% of sites lacked *P. obscurithorax*. This dropped to 65% in 2000, 39% in 2002, and 0% in 2006. At the same time, the number of sites with moderate to high densities increased. In our 2006 resurvey of Storz & Tschinkel's (2004) sites, we usually encountered *P. obscurithorax* nests within the first few meters.

A second comparison between the 2002 and 2006 surveys confirmed these findings. By resampling transects randomly from the data, we determined the relationship between the number of transects sampled and the number of *P. obscurithorax* nests encountered, the so-called rarefaction curves (Fig. 4). To adjust samples to be of equal size, we divided each of our 2006 transects into 4, each with the mean expected value of nests. For the same number of transects randomly resampled, nests accumulated much more rapidly in 2006 than in 2002, confirming their greater abundance, independent of the number of transects. Much of this effect was the result of the higher number of vacant transects in the 2002 samples.

What accounted for the differences in densities among the sites in 2006? We have already ruled out a large role for years-of-occupation. On the other hand, the colonies are not randomly distributed among the transects—a comparison of the observed with the expected Poisson distribution shows a surplus of low and high values and a deficit of mid-range values (Fig. 5). This suggests the operation of some non-random, site-specific factor affecting the frequency of nests. A possible clue is that sites with high densities of *P. obscurithorax* also had high densities of the fire ant, *S. invicta* (Fig. 6) (regression: $F_{1,43} = 20.4$; adjusted $R^2 = 31\%$;

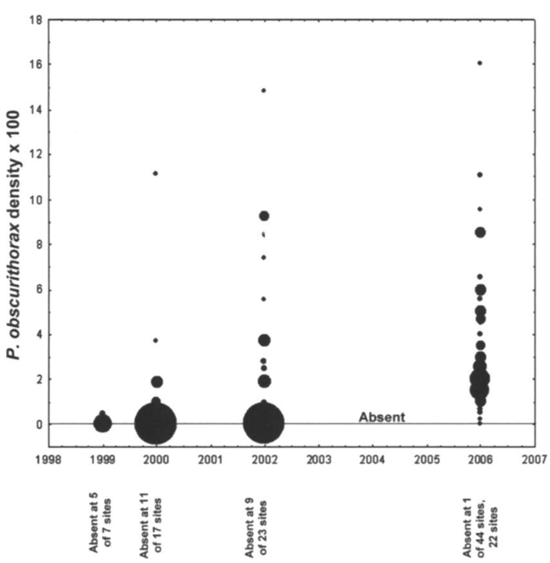

Fig. 3. Densities of *P. obscurithorax* (nests/100 m^2) at the survey sites, 1999-2006. Size of the symbol indicates the relative frequency of its y-value. Data prior to 2006 were taken from Storz & Tschinkel (2004).

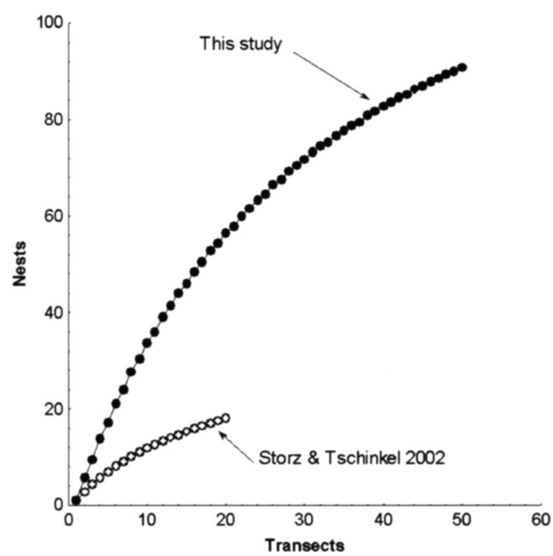

Fig. 4. The rate at which the number of *P. obscurithorax* nests accumulate upon random resampling of our data and those of Storz & Tschinkel (2004). Our 2006 transects were divided into 4 to be equivalent to those of Storz & Tschinkel (2004).

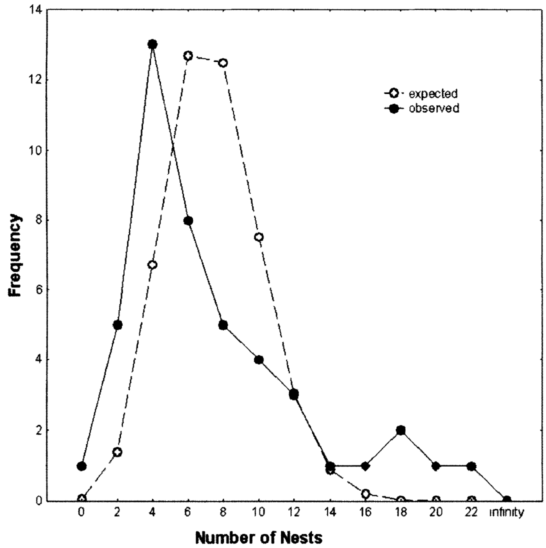

Fig. 5. The observed frequency distribution of *P. obscurithorax* nests among transects compared to the expected Poisson distribution. There are more high and low values and fewer mid-values than expected from a random distribution. Data for 2006 only.

$P < 0.00005$). For every additional fire ant colony per square meter, an additional 0.7 colonies of *P. obscurithorax* was present (note however, that fire ant colonies have 1.5 to 2 orders of magnitude more workers). Fire ants appeared in the Tallahassee area in the 1960s and their densities have been more or less stable for decades. This suggested that the density differences might be the result of site quality differences—in other words,

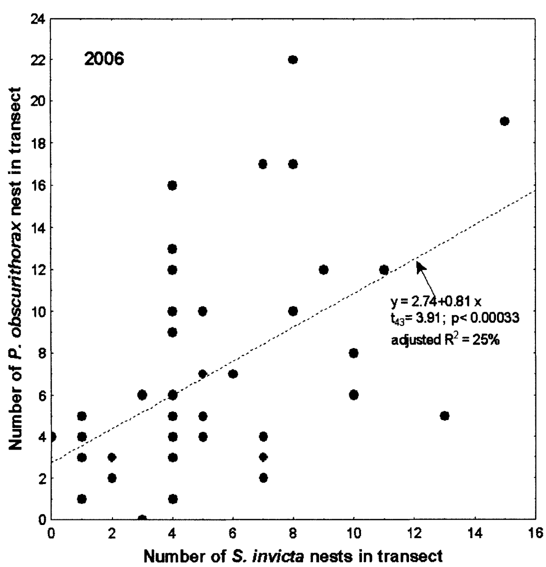

Fig. 6. The densities of fire ant nests in relationship to the densities of *P. obscurithorax* nests in the 2006 survey.

what is good for the fire ant is also good for *P. obscurithorax*. There is also some evidence that *P. obscurithorax* collects dead fire ants (and occasionally live ones) for food (Storz & Tschinkel 2004), often piling the spent fire ant corpses around their nests. There is also evidence that fire ants do not competitively suppress *P. obscurithorax* as removal of fire ants does not affect *P. obscurithorax* densities in pastures (King & Tschinkel 2006).

Discussion

Much like fire ants, *P. obscurithorax* has clearly found the southeastern United States to be quite congenial to its needs and is currently expanding its range across the disturbed habitat that comprises the bulk of the region. Its ongoing range expansion and biogeographic history suggest that *P. obscurithorax* may eventually occupy a range similar in size to that of *S. invicta*, at least in the United States. Unlike fire ants, however, *P. obscurithorax* is not considered a pest species, despite its local density. The obvious reason for this is that *Pheidole* do not sting and, in the case of *P. obscurithorax*, have never been documented to infest human dwellings or structures. Probably as a result of this, little is known of its biology. We know that it is a monogyne, dimorphic *Pheidole* species in the fallax group (Wilson 2003), occurs primarily in disturbed habitats, has large colonies (~10,000 workers, WRT unpublished data), and does not directly compete with *S. invicta* (King & Tschinkel 2006). We do not know the flight range of mated queens. We do not know how it is transported from place to place, although it seems most likely that mated queens (not colony fragments) are being transported in substrates such as potted plants. This species is the largest *Pheidole* in the southeastern United States (King & Porter 2007) and we do not know how its range expansion and population increase may impact co-occurring species, if at all. Because this species is currently expanding its range, we think that it might make an excellent study system for invasive ants, and invasive *Pheidole* in particular.

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