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## ANTS (HYMENOPTERA: FORMICIDAE) OF THE DRY TORTUGAS, THE OUTERMOST FLORIDA KEYS

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### ABSTRACT

We examined the distribution of ants on the Dry Tortugas, the outermost of the Florida Keys. These small islands are important nesting grounds for sea turtles and sea birds. We sampled ants on the five vegetated islands: Garden Key, Loggerhead Key, Bush Key, Long Key, and East Key. We found 17 ant species, seven of which had not been recorded from the Dry Tortugas. *Paratrechina longicornis* was common on four of five islands. Otherwise, the five islands had strikingly different ant faunas. On Garden Key, *Solenopsis geminata* was dominant, and *Pheidole megacephala* was absent. On Loggerhead Key and Bush Key, *Ph. megacephala* was dominant, and *S. geminata* was absent. On Long Key, vegetated primarily with mangrove, the most common ant was the arboreal *Pseudomyrmex elongatus*. On sparsely-vegetated East Key, all ants were uncommon. Twenty ant species are now known from the Dry Tortugas: eight New World and 12 Old World species. Only *Solenopsis globularia* is an undisputed Florida native. Florida specimens previously identified as *C. tortuganus* are actually *Camponotus zonatus*; true *C. tortuganus* are Bahamian. The two dominant ant species, *Ph. megacephala* and *S. geminata*, may pose a threat to native fauna, including sea turtle and sea bird nestlings.

Key Words: *Camponotus tortuganus*, exotic species, *Solenopsis geminata*, tramp ants, *Pheidole megacephala*

### RESUMEN

Examinamos la distribución de hormigas en las Dry Tortugas, las islas más exteriores de las Florida Keys. Estas islas pequeñas son áreas importantes para nidos de las tortugas del mar y de los pájaros del mar. Muestreamos hormigas en las cinco islas vegetadas: Garden Key, Loggerhead Key, Bush Key, Long Key, y East Key. Encontramos 17 especies hormigas; siete de estas no fueron registrados de Dry Tortugas. *Paratrechina longicornis* eran comunes en cuatro de cinco islas. De otras maneras, las cinco islas tenían llamativo diversos faunas de la hormiga. En Garden Key, *Solenopsis geminata* era dominante, y *Pheidole megacephala* estaba ausente. En Loggerhead Key y Bush Key, *Ph. megacephala* era dominante, y *S. geminata* estaba ausente. En Long Key, vegetada sobre todo con el mangle, la hormiga más común era la arboreal *Pseudomyrmex elongatus*. En East Key, una isla sin mucha vegetación, las hormigas en general eran raro. Viene especies de las hormigas están conocidas de las Dry Tortugas ahora: ocho especies del mundo viejo y 12 del mundo nuevo. Solamente *Solenopsis globularia* esta nativa de la Florida sin disputación. Los especímenes de la Florida identificada previamente como *C. tortuganus* es realmente *Camponotus zonatus*; *C. tortuganus* verdadero es de las Bahamas. Las dos especies dominantes de la hormiga, *Ph. megacephala* y *S. geminata*, pueden plantear una amenaza a la fauna nativa, incluyendo las juveniles de la tortuga marinas y del pájaro del mar.

The Dry Tortugas (24°33'-24°44'N; 82°46-83°15'W) are the outermost of the Florida Keys, located 100-112 km West of Key West, Florida. These islands and the surrounding waters were declared a wildlife refuge in 1908, a national monument in 1935, and a national park in 1992. Most biological research in the Dry Tortugas area has concerned the diverse marine biota in the coral reefs surrounding the keys (see Schmidt & Pikula 1997 for an annotated bibliography of research). The Dry Tortugas are also important ecologically as the feeding and nesting grounds for loggerhead turtles (*Caretta caretta*), green sea turtles (*Chelonia mydas*), and numerous sea birds, including masked boobies (*Sula dactylatra*), brown boobies (*Sula leucogaster*), sooty terns (*Sterna fuscata*),

and magnificent frigate birds (*Fregata magnificens*) (Robertson 1964; Lenihan 1997). The islands are far from pristine and have numerous non-indigenous plants and animals (Stoddart & Fosberg 1981), such as wetland nightshade (*Solanum tampicense*; Fox & Bryson 1998) and the Old World house gecko (*Hemidactylus mabouia*; Meshaka & Moody 1996). In the present study, we examined the distribution of native and exotic ants on the Dry Tortugas.

Hurricanes periodically reshape the Dry Tortugas, altering the size and even the number of keys (Stoddart & Fosberg 1981). Currently, there are seven keys: (from west to east) Loggerhead Key, Garden Key, Bush Key, Long Key, Sand Key, Middle Key, and East Key. Garden Key and Log-

gerhead Key are the largest and the only inhabited islands. At present, about ten park staff members live on these two keys. Garden Key is the site of Fort Jefferson, a 19th century structure that occupies most of the island. Plans are being made to expand tourist facilities on Garden Key to accommodate the large number of people who visit the Dry Tortugas each year (almost 90,000 in 1999; Dustin 1999). Loggerhead Key has a Coast Guard Station and lighthouse and is the former site of Tortugas Laboratory, a research station administered by the Carnegie Institute from 1904 to 1939 (Mayer 1902; Schmidt & Pikula 1997). Bush Key is an important breeding site for many seabirds. It is currently connected by a sand spit to Long Key, which is largely vegetated with mangroves. East Key is a small, sparsely vegetated island far to the east of the other keys. Finally, the smallest two islands, Sand Key and Middle Key, are simple sand bars without vegetation.

The aim of my study was to establish a baseline of information on the distribution of ants in the Dry Tortugas, as a first step in evaluating the potential impact of ants on native species on the islands.

#### MATERIALS AND METHODS

In addition to compiling published records on ants, we surveyed the ants on the five vegetated islands of the Dry Tortugas, Loggerhead Key, Garden Key, Bush Key, Long Key, and East Key, on 17-19 March 2000 during daylight hours, with the help of undergraduate assistants from the Honors College of Florida Atlantic University. We did not sample on the unvegetated Sand Key and Middle Key because these islands are periodically submerged for extended periods, and thus have no permanent ant populations.

To evaluate the overall variety of ant species present on each island, we conducted intensive hand-collecting, searching accessible surfaces and turning over rocks and logs.

To evaluate the relative dominance of different ant species on Garden Key, we surveyed ants at 40 bait stations, each with two bait cards. A bait card consisted of a 7.6 × 12.7 cm index card with approximately 2 g of tuna bait placed at its center. We folded each card in half and placed it flush with the ground about one meter from the road, trail, transect, or building, using a small rock or branch to weigh it down. We returned to each station 1.5-2.0 hours later and placed the cards, along with all ants on the bait, in plastic bags.

#### RESULTS

##### Published Ant Records

In addition to one questionable record, we found reports of 14 ant species from the Dry Tortugas

(Table 1; Emery 1895; Mayor 1922; Wheeler 1932; MacArthur & Wilson 1967; Deyrup et al. 1988).

The questionable record from the Dry Tortugas is the earliest. Emery (1895) described *Camponotus tortuganus* based on specimens that he believed were collected by T. Pergande in the Dry Tortugas. Mackay (pers. comm.), however, found that the collection locality for Emery's *C. tortuganus* holotype specimen was labeled in Emery's handwriting as Egg Island, Bahamas. Also, Mackay (pers. comm.) has received additional specimens from the Bahamas that match the *C. tortuganus* holotype. In contrast, Mackay (pers. comm.) found that all "*C. tortuganus*" specimens from Florida that he examined are actually *Camponotus zonatus* (formerly *Camponotus conspicuus zonatus*). Mackay (pers. comm.) suggested that Emery erroneously attributed the Dry Tortugas as the type locality for *C. tortuganus* and that true *C. tortuganus* is Bahamian.

The next mention of ants from the Dry Tortugas come from Cole (1906), who worked at Tortugas Laboratory on Loggerhead Key, and reported that he "studied the reactions of ants" there. It appears that this work was never published, and we could not find any Cole specimens.

Mayor (1922) studied an Old World exotic ant, *Monomorium destructor*, on Loggerhead Key, describing it as "a great pest in the wooden buildings of Tortugas Laboratory, making its nests in crevices of the woodwork. So voracious are these insects that we are obliged to swing our beds from the rafters and to paint the ropes with a solution of corrosive sublimate, while all tables must have tape soaked in corrosive sublimate wrapped around their legs if ants are to be excluded from them. These pests have the habit of biting out small pieces of skin, and I have seen them kill within 24 hours rats which were confined in cages." Mayor (1922) mentioned no other ant species on the island.

Wheeler (1932), in his review of ant records from Florida, listed 91 species, including only two species from the Dry Tortugas, both collected by Pergande (again, presumably from Garden Key): *Camponotus tortuganus* and *Tetramorium guineense* (now *Tetramorium bicarinatum*).

Wilson's (1964) survey of the ants of the Florida Keys did not include any records from the Dry Tortugas. MacArthur & Wilson (1967) stated that 13 ant species "have succeeded in colonizing the Dry Tortugas," but only mentioned two species by name, *Paratrechina longicornis*, and *Pseudomyrmex elongatus*. MacArthur & Wilson (1967) reported that on the Dry Tortugas, *Paratrechina longicornis* was "an overwhelmingly abundant ant and has taken over nest sites that are normally occupied by other species in the rest of southern Florida: tree-boles, usually occupied by species of *Camponotus* and *Crematogaster*, which are absent from the Dry Tortugas; and open soil,

TABLE 1. ANTS OF THE DRY TORTUGAS.

	Key					Status
	Loggerhead	Garden	Bush	Long	East	
<i>Brachymyrmex obscurior</i> Forel		f2				NW/N?
* <i>Camponotus tortuganus</i> Emery		a*				?
<i>Camponotus zonatus</i> Emery		f0		f		NW/N?
<i>Cardiocondyla ectopia</i> Snelling	f		f			OW/E
<i>Cardiocondyla emery</i> Forel		df0				OW/E
<i>Cardiocondyla venustula</i> Wheeler		f1			f	OW/E
<i>Cardiocondyla wroughtoni</i> (Forel)		f0				OW/E
<i>Hypoponera opaciceps</i> (Mayr)		d				NW?/N?
<i>Monomorium destructor</i> (Jerdon)	b					OW/E
<i>Monomorium floricola</i> (Jerdon)	f	df6			f	OW/E
<i>Paratrechina bourbonica</i> (Forel)	f	df5	f		f	OW/E
<i>Paratrechina guatemalensis</i> (Forel)		e		f		NWE
<i>Paratrechina longicornis</i> (Latr.)	f	cdef14	f	f		OW/E
<i>Pheidole megacephala</i> (Fabr.)	f	de	f			OW/E
<i>Pseudomyrmex cubaensis</i> Forel	f					NW/N?
<i>Pseudomyrmex elongatus</i> (Mayr)		df0	cf	f	f	NW/N?
<i>Solenopsis geminata</i> (Fabr.)		def28				NW/N?
<i>Solenopsis globularia</i> (Smith)	f	f1	f			NW/N
<i>Tapinoma melanocephalum</i> (Fabr.)		def3				OW/E
<i>Tetramorium bicarinatum</i> Nylander		a				OW/E
<i>Tetramorium caldarium</i> (Roger)		df6			f	OW/E

Collectors/Authors: a\* = Pergande (in Emery 1895) a = Pergande (in Wheeler 1932); b = Mayor (1922); c = MacArthur & Wilson (1967); d = Winegarner (in Deyrup et al. 1988); e = Carlin (in Deyrup et al. 1988); f = present study (including # of Garden Key bait stations with the species present); \* = apparently erroneous record. Status (from Deyrup et al. 1988, 2000): NW = New World origin; OW = Old World origin. N = native; E = exotic; ? = status in question.

normally occupied by crater nests of *Conomyrma* [now *Dorymyrmex*] and *Iridomyrmex* [now *Forelius*], which genera are also absent from the Dry Tortugas." MacArthur & Wilson (1967) also reported that *Pseudomyrmex elongatus* was "the only member of the arboreal assemblage that has colonized the Dry Tortugas, where it has a red mangrove swamp on Bush Key virtually to itself. Yet it is still limited primarily to thinner twigs in the canopy and, unlike *Paratrechina longicornis*, has not increased perceptibly in abundance."

Deyrup et al. (1988), in their review of the ants of the Florida Keys, included records from recent collections in the Dry Tortugas by C. Winegarner (collected 12 April 1983; no island site locality, presumably from Garden Key) and by N. F. Carlin (no island site locality, presumably from Garden Key). These two collections recorded a total of 11 ant species from the Dry Tortugas, bringing the total number of previously published ant records to 14 species (Table 1). Although Deyrup et al. (1988) reported *Pheidole dentata* specimens collected by Winegarner, these were actually misidentified *Pheidole megacephala* specimens (M. Deyrup, pers. comm.).

#### New Ant Collection

We collected 17 ant species on the Dry Tortugas (Table 1). Seven of these were not previously

recorded from the Dry Tortugas. One species, *Brachymyrmex obscurior*, belongs to a genus in which species boundaries for Florida specimens have not been adequately defined (Deyrup 1991). We did not find four species recorded in previous studies: *Camponotus tortuganus* (see discussion above), *Tetramorium bicarinatum*, *Monomorium destructor*, and *Hypoponera opaciceps*.

*Paratrechina longicornis* was common on four of the five islands. Otherwise, the five islands had strikingly different ant faunas. On Garden Key, *Solenopsis geminata* and *Paratrechina longicornis* were by far the most common ants at baits, found, respectively at 28 and 14 of the 40 bait stations (Table 1). *Solenopsis geminata* was the dominant ant on the ground, while *Paratrechina longicornis* was the most common ant up in trees. On Loggerhead Key and Bush Key, *Pheidole megacephala* and *Paratrechina longicornis* were the most common ants. *Solenopsis globularia*, which we found only once on Garden Key, was common on Loggerhead and Bush Key. On Long Key, vegetated primarily with mangrove, the most common ant was the mangrove-inhabiting *Pseudomyrmex elongatus*. On sparsely vegetated East Key, all ants were uncommon.

We collected *Camponotus* specimens on both Garden Key and on Long Key. On Garden Key, we found *Camponotus* workers foraging in trees and

we collected dead *Camponotus* workers and males from the windowsills of a park warden's house. On Long Key, we found *Camponotus* workers inside a bamboo pole near the beach. Mackay (pers. comm.) examined all my *Camponotus* specimens and found that they did not match Emery's *C. tortuganus* holotype, but instead were *Camponotus zonatus*.

#### DISCUSSION

Excluding *Camponotus tortuganus*, which appears to be an erroneous record, 20 ant species are recorded from the Dry Tortugas (Table 1), 12 of Old World origin and eight from the New World. Only one species, *Solenopsis globularia*, is an undisputed Florida native. Of the other seven New World species, Deyrup et al. (2000) considered *Paratrechina guatemalensis* as an exotic in Florida and listed *Brachymyrmex obscurior*, *Camponotus tortuganus* (= *Camponotus zonatus*), *Solenopsis geminata*, *Pseudomyrmex cubaensis*, and *Pseudomyrmex elongatus* as "dubious natives." In addition, although Deyrup et al. (1988) considered *Hypoponera opaciceps* as native to the Florida Keys, Dlussky (1994) has proposed that this species is actually of Old World origin.

We found a strikingly different ant fauna on each of the five vegetated keys of the Dry Tortugas. On Garden Key, *Solenopsis geminata* was the dominant ant species, occurring at 70% of the bait stations, usually with several hundred workers on each bait card. Their presence on the island was noted by visitors who were often stung on the feet by these fire ants. Although *Pheidole megacephala* may have occurred at one time on Garden Key, we found none. In contrast, we found no *S. geminata* on any other key in the Dry Tortugas. Instead, on Loggerhead Key and Bush Key, *Ph. megacephala* was the dominant ant.

Wheeler (1908) similarly observed mutually exclusive distributions of *Ph. megacephala* and *S. geminata* on two Caribbean islands: "I devoted ten days to a careful study of the ant-fauna of the little island of Culebra off the eastern coast of Porto Rico without seeing a single specimen of *Ph. megacephala*. This island is, however, completely overrun with a dark variety of the vicious fire-ant (*Solenopsis geminata*). One day, on visiting the island of Culebrita, which is separated by a shallow channel hardly a mile in width from the eastern coast of Culebra, I was astonished to find it completely overrun with *Ph. megacephala*. This ant was nesting under every stone and log, from the shifting sand of the sea-beach to the walls of the light-house on the highest point of the island. The most careful search failed to reveal the presence of any other species, though the flora and physical conditions are the same as those of Culebra. It is highly probable that *Ph. megacephala*, perhaps accidentally introduced from the island

of St. Thomas a few miles to the east, had exterminated all the other ants which must have previously inhabited Culebrita. The absence of *megacephala* on Culebra is perhaps explained by the presence of the equally prolific and pugnacious fire-ant" (Wheeler 1908). Mutually exclusive distributions between pairs of dominant ant species has also been noted for many other species, such as between *Ph. megacephala* and *Linepithema humile* on Madeira (Schmitz 1896) and Bermuda (Haskins & Haskins 1965).

*Paratrechina longicornis* coexisted at high densities with both *Solenopsis geminata* (on Garden Key) and *Ph. megacephala* (on Loggerhead Key and Bush Key). An Old World native, *P. longicornis* now has a pantropical distribution and commonly occurs at high densities in disturbed habitats (e.g., see Wetterer 1998, Wetterer et al. 1999).

Remarkably, *Monomorium destructor*, found in such overwhelming abundance on Loggerhead Key by Mayor (1922), was not found on any island in the Dry Tortugas by later collectors. It is possible that *M. destructor* only dominated the Tortugas Lab buildings which have subsequently been torn down. Deyrup et al. (1988) wrote that *M. destructor* "is not common in Florida, and may be on the decline in the Keys, except in Key West where it is a dominant urban ant." Deyrup (1991) wrote that *M. destructor* "is spectacularly common on Key West." It is possible that *Ph. megacephala* and/or *S. geminata* competitively excluded *M. destructor* from the Dry Tortugas.

The two dominant ant species of the Dry Tortugas, *S. geminata* and *Ph. megacephala*, may pose a threat to the native fauna of the Dry Tortugas. *Pheidole megacephala*, an African native, is now a pantropical pest. In lowland Hawaii, it has been implicated in the extermination of much of the endemic fauna (Zimmerman 1948). Zimmerman (1948) reported that the "voracious immigrant ant," *Ph. megacephala*, eliminates most endemic insects throughout its range. *Solenopsis geminata* is an important exotic pest on Pacific islands (Wetterer 1997). On the Dry Tortugas, this species may prey on hatchling sea turtles and birds (e.g., see Kroll et al. 1973; Wetterer & Wood 2001).

Two highly-destructive exotic ant species known from the Florida Keys that also pose important threats to native species (e.g., see Vinson 1994; Jourdan 1997; Wetterer & Wood 2001) are the red imported fire ant, *Solenopsis invicta*, and the little fire ant, *Wasmannia auropunctata* (Deyrup et al. 1988, Horvitz 1997). These species are not yet known from the Dry Tortugas. Construction of new tourist facilities on the Dry Tortugas may result in the introduction of these and other exotic ant species, arriving with building material or heavy machinery during the building stage, or accompanying visitors in their camping supplies and picnic baskets. On the Dry Tortugas, a relatively small effort in preventing the further inva-

sion of exotic ants could have a great effect in protecting the native inhabitants of these ecologically important islands.

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