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First record of the emerging global pest *Brachymyrmex patagonicus* Mayr 1868 (Hymenoptera: Formicidae) from continental Asia

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ABSTRACT. The first record of the exotic ant *Brachymyrmex patagonicus* Mayr 1868 from continental Asia is here presented. Specimens collected from an urban environment in Hong Kong coupled with recent surveys suggest an early stage in the invasion process. The summary of recent records shows that the introduced range of this species is quickly increasing globally and biologists in Asia should remain vigilant to detect it. In Hong Kong, measures to identify its overall spread and to eradicate this species, which is considered as a major pest, should be quickly implemented.

Keywords: *Brachymyrmex patagonicus*, Hong Kong, Tropical Asia, Introduction, Urban Ecosystems, Tramp Ant.

The ant genus *Brachymyrmex* is native to the New World and widely distributed from southern Canada to the Patagonian region of Argentina (antmaps.org, Guénard *et al*. 2017). The genus diversity is relatively modest and currently includes 44 valid species, 17 valid subspecies and a good reservoir of potentially undescribed species (Deyrup 2016). However, five species have been recorded as introduced outside their native ranges: *B. cordemoyi* Forel 1895, *B. heeri* Forel 1874, *B. minutus* Forel 1893, *B. obscurior* Forel 1893, and *B. patagonicus* Mayr 1868. The latter species is arguably the most widespread *Brachymyrmex* species and its introduced range has quickly expanded in the past decade based on recent records summarized below. Here the first record of *B. patagonicus* from continental Asia is reported from Hong Kong.

Brachymyrmex patagonicus is native to South America and has been reported from the southern Argentinean province of Santa Cruz north to Venezuela and the Guiana Shield, and from the eastern Brazilian states of Pernambuco and Paraiba to Ecuador in the west (antmaps.org, Guénard *et al*. 2017). Though the native range has sometimes been presented as limited to Argentina or Paraguay (e.g. MacGown *et al*. 2007, Hill 2017), its distribution in South America is thus more extensive, and ecological results suggest that the native range of *B. patagonicus* could extend further. For instance, in a study conducted within the northern part of the Cerrado ecoregion (Maranhão state, Brazil), *B. patagonicus* was found to be an indicator species of interior forest, a habitat less exposed to disturbance in comparison to forest edges and agricultural fields (Brandão *et al.* 2011). However, it should also be noted that within the Neotropical realm, *B. patagonicus* is frequently encountered within disturbed open habitats or anthropogenic habitats (Delabie *et al.* 2009, Santos-Silva *et al*. 2016, Golias *et al.* 2018) suggesting that some populations could represent more recent introductions. Determining the exact native range of this species within South America is thus needed at this point.

Within the United States, where the species is non-native, MacGown and collaborators reported *B. patagonicus* from seven states in 2007

(Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas and Texas) but in just 12 years, additional records from California (Martinez *et al.* 2011), North Carolina (Guénard *et al.* 2012), Arizona (MacGown *et al.* 2013), New Mexico (MacGown *et al.* 2013), South Carolina (MacGown *et al.* 2013), Missouri (Trager 2014), Nevada and Tennessee (Hill 2017) have been reported, with *B. patagonicus* now widespread within the southern American states from coast to coast across 15 states. In the Caribbean region, *B. patagonicus* is known from the Bahamas (Wheeler & Wheeler 1978) and was recently reported from Martinique (Carval *et al.* 2016).

In the Old World, *B. patagonicus* has been reported in Europe from greenhouses of the Kew Gardens, London (England) since 1909 and more recently in the early 2000's from greenhouses and zoos in the Netherlands (Vierbergen 2003, Boer & Vierbergen 2008). However, for both countries, it is uncertain if these populations persist (e.g. see Brangham 1938) and no outdoor populations have been reported. The situation differs in Spain, where *B. patagonicus* was recently reported from the coastal city of Almería (Almería province) where it was collected both indoors and outdoors (Espadaler & Pradera 2016). In Asia, a single record of *B. patagonicus* has been reported from the harbor area of Kobe, Hyogo prefecture, Japan (Terayama *et al.* 2014), however further investigation to determine if this population remains and has been able to survive the cooler climate of the region would be welcome.

Because of its small size and the lack of a recent and comprehensive taxonomy, the genus *Brachymyrmex* has caused much confusion historically among ant biologists (MacGown *et al.* 2007, Deyrup 2016). For instance, early records of the Mesoamerican species *B. musculus* Forel 1899 from the USA and the Bahamas (Wheeler & Wheeler 1978) were misidentifications of *B. patagonicus* in (MacGown *et al.* 2007). Similarly, early records of *B. brevicornis* from Florida (Deyrup *et al*. 2000) represent an undescribed species of *Brachymyrmex* (MacGown *et al.* 2007), or the record of *B. aphidicola* Forel 1909 from Hawaii (Wheeler 1934) represents a misidentification of *B. obscurior* (Huddleston & Fluker 1968). Recent taxonomic work initiated by Quirán and collaborators (2004) and later completed by MacGown and collaborators (2007) defined *B. patagonicus* from the following morphological characters (briefly summarized here): brownish-yellow scapes exceeding the occipital margin of head by

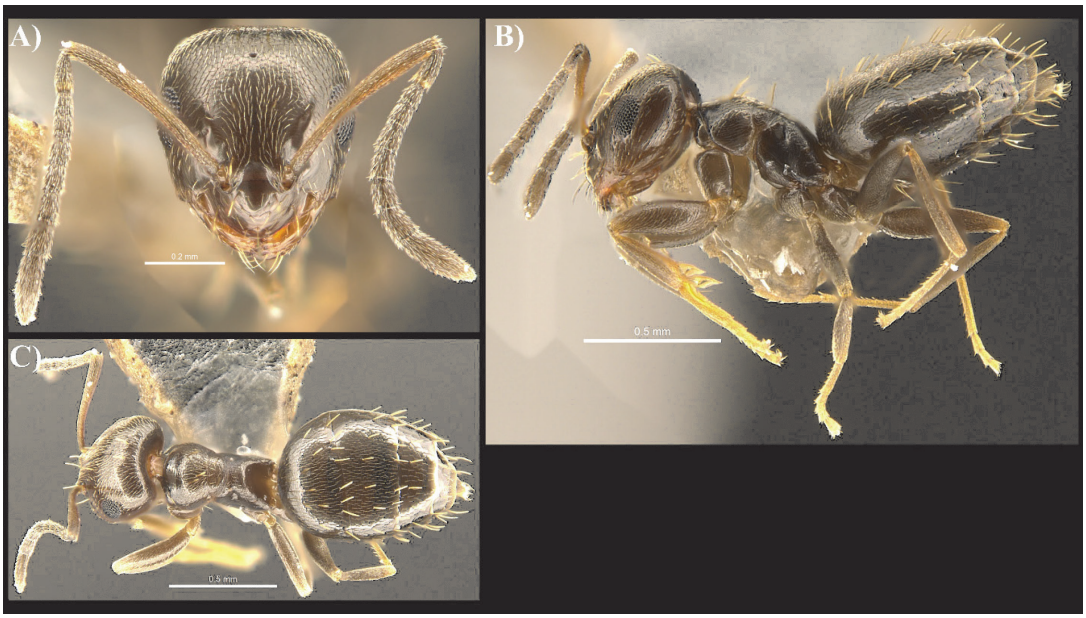

Figure 1: Pictures of a specimen of *B. patagonicus* collected from Hong Kong showing A) a head, B) a profile and C) a dorsal view.

1/5 of their total length, eyes well-developed and as large as the malar space, decumbent pubescence on head and gaster sparse with the presence of a few long and scattered erect hairs, promesonotum with a few erect hairs (3 to 9) on dorsum when specimens observed in profile view. These morphological characters are clearly observed on the specimens collected in Hong Kong (Figure 1) from Kowloon, Hung Hom district, waterfront, 22.302074N, 114.191298E, 4 m elev., 11 & 16 December 2018, B. Guénard col.

The collecting site in Hong Kong is located at the tip of a zone of reclaimed land and heavily urbanized. The specimens were first observed foraging at the base of two planted *Araucaria heterophylla* (Salisb.), an introduced tree species within a landscaped urban habitat. Foraging activities were observed on December 11th in the morning at 8:45am and around 10:30am. At the time of the initial observation, atmospheric temperature was close to 17°C, and while the bark surface was directly exposed to the sun, constant wind likely cooled the surface. On the afternoon of December 16th (3 to 4:30pm), additional sampling was performed using baits (cookie crumbs) to collect more workers and other species in the vicinity. Over 60 workers of *B. patagonicus* were observed, including a few meters away from the original sites (within a radius of 5m) on bare ground and lawn (Figure 2). A few individuals were observed at collecting baits, however no mass-recruitment was observed despite the high ground temperature measured (22.7°C to 25.8°C). While workers were observed using a similar trail suggesting the potential use of pheromonal communication, the density of workers observed was low. Three other ant species were observed in the same area, *Pheidole megacephala* (Fabricius, 1793) which appeared dominant on baits, and more rarely *Paraparatrechina sauteri* (Forel, 1913) and *Cardiocondyla minutior* Forel, 1899; the latter is here recorded for the first time

Figure 2: Landscape habitat where *B. patagonicus* was found in Hung Hom, Hong Kong. White arrows indicate areas where the species was found foraging.

in Hong Kong as well and was recently collected from the nearby territory of Macao (Leong *et al.* 2017). The presence of *B. patagonicus* at the basis of a coniferous species is worth noting as the association of this ant with pine trees has been reported previously in its North American introduced range (MacGown *et al.* 2007, Hill 2017) as well as in its native range in association with exotic pine trees in Patagonia (Corley *et al*. 2006). The presence of *B. patagonicus* within landscaped habitat and heavily urbanized environment (Figure 2) is similar to observations in collecting sites in other introduced regions such as southern Spain (Espadaler & Pradera 2016), or North Carolina, USA (North Carolina State University Campus: Guénard *et al.* 2014).

Risks for Hong Kong and Asia

In both its native and introduced ranges, *B. patagonicus* inhabits a variety of habitats along a wide gradient of disturbance. The ability of this species to colonize both natural habitats such as woodlands, mangroves (Moreau *et al*. 2014), grasslands (Calcaterra *et al.* 2016) or beaches (MacGown *et al.* 2007) as well as disturbed habitats such as tree plantation, agricultural fields (Delabie *et al.* 2009, Golias *et al.* 2018) or urban habitats (MacGown *et al.* 2007), including indoor structures should allow *B. patagonicus* to spread widely in subtropical and tropical Asia in the absence of control measures. Though particular studies on the impacts of *B. patagonicus* on native arthropods are at this point lacking, it has been noted that this species was often found co-occurring with other ant species (MacGown *et al.* 2007). In Hong Kong its presence in the vicinity of an area invaded by *P. megacephala* is worth noting. Several studies also noted that *B. patagonicus* was particularly attracted to carbohydrates originating from plants or hemipteran insects (MacGown *et al.* 2007, Buffa *et al.* 2009). In the latter case, if *B. patagonicus* represents an efficient guard for honeydew-producing insects, then it might favor herbivorous insect outbreaks or limit the efficiency of biological control programs of these insects.

Within urban settings, *B. patagonicus* is considered to be a major pest due to the nuisance the species creates in entering buildings (MacGown *et al.* 2007). For instance, in separate studies conducted in hospitals, *B. patagonicus* has been recorded as one of the most frequent and abundant species found in several room types including kitchens, offices, and laundry rooms, but also more sensitive areas such as infirmaries and neonatal units (dos Santos *et al.* 2009, Josens *et al*. 2014, de Castro *et al*. 2016). This species also colonizes or forages within administrative buildings (e.g. schools) as well as households or hotels and was recognized in Mississippi as the pest causing the most frequent interventions from pest control companies due to its high nesting plasticity and the difficulties to control populations (MacGown *et al.* 2007). While the species is not anticipated to directly damage building structures or cause health problems, its high abundance within buildings will nonetheless be considered a nuisance by users (MacGown *et al*. 2007). Its spread across Hong Kong and Asia could thus lead to an economic burst in pest management costs and to an increase in the release of insecticides in the environment. Since 2014, important efforts have been deployed in both natural and urban environments of Hong Kong to characterize the local myrmecofauna (unpublished results) but it should be noted that no other records of *B. patagonicus* have been reported to date. Moreover, a rapid inspection of nearby landscaped areas did not uncover other workers of *B. patagonicus*. This indicates that the introduction of *B. patagonicus* in Hong Kong might be recent, offering an opportunity for the detection and eradication of the species before it becomes established.

If the record of *B. patagonicus* in Hong Kong represents an example of long-jump dispersal - on the basis of previous records a 2500 km from Japan, or cross-continental dispersal from Europe or the New World – this is not surprising. Hong Kong represents one of the major hubs for trade in Asia and several exotic ant species have already been recorded. For instance, Hong Kong has been hypothesized to be entry point of *S. invicta* in mainland China (although the neighboring city of Shenzhen has also been proposed;

reviewed in Wang *et al*. 2013) and several new records of exotic or tramp species have recently been recorded (Tang et al. *in review*, unpublished results). This confirms the continuous accumulation of exotic species across the globe and the invasion of new regions (Seebens *et al.* 2018), but also the potential role that Hong Kong might play as a stepping stone for invasion to other parts of the world (Lu *et al*. 2018) generating an urgent need for early detection and control measures to be implemented.

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