

UNCORRECTED PROOF

Taxonomic confusion of two tramp ant species: *Iridomyrmex anceps* and *Ochetellus glaber* are really species complexes

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Abstract Many invasive invertebrates belong to unresolved species complexes, and have a history of misidentification and inappropriate management. Here we detail confusion surrounding the taxonomy and identification of two dolichoderine ant species, *Iridomyrmex anceps* Roger and *Ochetellus glaber* Mayr, which are commonly cited in the literature as having been spread widely by human commerce. We provide morphometric data and images strongly suggesting that these two “species” are instead complexes of species that are likely native to many regions where they are purportedly introduced. We take particular interest in the status of species referred to as *I. anceps* and *O. glaber* in China, as this is the most northerly distribution of both genera. We conclude by suggesting that many identifications of both species are likely to be unreliable, and we recommend against any management action aimed at controlling these species under the assumption that they are exotic [*Current Zoology* 57 (5): –, 2011].

Key words Ant, Exotic, Invasive, Invertebrate, Management, Tramp ant

The human-mediated spread of species is an increasing problem globally, requiring ever greater management action (Mack et al., 2000; Simberloff, 2009; Scalera, 2010). The first step of managing an exotic invader is the accurate identification of the alien species. However, many invertebrate taxa remain poorly understood taxonomically, making species-level identifications of potentially exotic species often unreliable or impossible. This is not a trivial issue. The tobacco whitefly *Bemisia tabaci*, one of the most significant insect pests of agriculture (Lowe et al., 2000), provides a good example. The species has a confused taxonomic history, with many forms that overlap morphologically but show strong host specificity (Bird, 1957; Perring, 2001) and high variation in insecticide tolerance (He et al., 2007; Ma et al., 2007). Recent molecular analysis has identified many distinct genotypes, and it is now widely accepted that *B. tabaci* is really a species complex (Perring, 2001). Notably, only two of the forms (species) are invasive, so that proper taxonomic resolution is critical for understanding potential impacts and management options.

As a taxon, ants are overrepresented as invasive species, contributing 6% of the world’s 100 most significant invaders (Lowe et al., 2000). Invasive ant management has a poor history of success (Hoffmann et al., 2010), and taxonomic confusion has often been a contributing factor (Williams et al., 2001; Tschinkel, 2006; Hoffmann et al., 2010). Most recently, an undescribed species of *Nylanderia* (formerly *Paratrechina*) was introduced to the USA, where it has rapidly spread (Meyers and Gold, 2008; www1, 2); due to the poor species-level taxonomy of this genus (LaPolla et al., 2010), it is not possible to match with confidence this exotic ant to any described species.

Here we detail confusion surrounding the taxonomy and identification of two dolichoderine ant species, *Iridomyrmex anceps* Roger and *Ochetellus glaber* Mayr, which are commonly cited in the literature as having been

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spread widely by human commerce. We use morphometric analyses to provide strong evidence that these two “species” are in fact complexes of species that are likely native to many regions where they are purportedly introduced. These species are the only representatives of their respective genera in many places where they occur, and so determining if they are native or introduced has important implications for a broader understanding of ant biogeography. We particularly address the status of these taxa in China, as this country represents their most northerly ranges, and their status (and therefore that of their genera) as native or introduced is contentious. China lies within the potential range of many other invasive ants (Morrison et al., 2004), and the country’s recent economic boom has greatly increased its risk of invasion, as has recently occurred with the red imported fire ant *Solenopsis invicta* (Zeng et al., 2005).

1 Materials and Methods

Our analyses are based on specimens held in the CSIRO Tropical Ecosystems Research Centre (TERC) in Darwin, which holds extensive collections of both species complexes. Our species concept is based on the notion of reproductive isolation, with gene flow actually or potentially occurring between populations throughout a species’ range. In the absence of genetic data, this is made operational through the recognition of clear morphological discontinuities that are maintained when ranges overlap. For geographically separated populations, the taxonomic significance of any morphological variation needs to be assessed on the basis of known variation in widely distributed species that have been well-studied taxonomically.

In a recent revision of *Iridomyrmex*, *I. anceps* is presented as a single species ranging from northern Australia through the Indo-Pacific region as far north as China, as one of only a few species of this highly diverse genus occurring outside Australia (Heterick and Shattuck, 2011). The revision synonymized six described subspecies under the nominal species, on top of the five previous synonymies. This synonymy was conducted in the complete absence of any morphometric analysis. In contrast, the TERC collection recognizes more than a dozen species. We focus on five of these taxa that have overlapping ranges in Australia and South-East Asia (Fig.1): sp. A – the most common Australian species in the complex, occurring throughout the far north of the continent; sp. B – co-occurring with sp. A in North Queensland, and extending into Papua New Guinea (this taxon is possibly *I. gracilis papuana* Emery); sp. C – a peculiarly hairy species from Timor; sp. D – a species also occurring in Timor, and widely throughout South-East Asia; and sp. E – a species with very short antennal scapes from Singapore.

The type specimen of *I. anceps* appears to have been lost (Heterick and Shattuck, 2011), but we suspect that it might be sp. D because this appears to be the most common and widespread species in South-East Asia. We obtained morphometric measurements (scape length, head length and head width) from specimens representing the full geographic and morphological range of each species as represented in the TERC collection (Fig.2; $n = 27, 23, 8, 20$ and 8 workers measured respectively). The mean scape length relative to head length of each species was statistically analyzed using One-way ANOVA in the software package Statistica. Homogeneity of data was confirmed using Cochran’s Test, and Post-hoc comparisons were made using Tukey HSD Test.

Ochetellus has its centre of diversity in Australia, but its range extends north to the southern half of Japan, west as far as India and Mauritius, and east into the Pacific as far as Fiji (Shattuck, 1999). Species of the *O. glaber* complex do not show such clear morphometric differentiation, but can be separated by variation in sculpture, mesosoma morphology, and presences and color of iridescence. *Ochetellus glaber* has been referred to as being a tropical species (Cornelius and Grace, 1997), but the type specimen is from Sydney in temperate southeastern Australia (Mayr, 1862). We have not been able to locate the type specimen. The TERC collection shows that two species from the *I. glaber* complex are common in the Sydney region; these have contrasting sculpture, with the head densely punctate in one, and shagreened in the other (Fig.3). It is not clear which, if either, is *I. glaber*. Both are widespread in eastern and

southern Australia. For comparison, we present images of a range of species from outside Australia identified as *I. glaber* on the ant web sites AntWeb (www3) and Japanese Ant Image Database (www4).

For both complexes, Chinese distributional data were obtained from the Global Ants website (Guénard et al., 2010), supplemented by the ant collection at Guangxi Normal University, Guilin, Guangxi Province. We also conducted opportunistic hand collections of both genera in Fujian Province, China in 2009 at Wuyishan Mountain (27° 43' N, 118° 03'E; *Iridomyrmex* only), and Longyan (25° 05' N, 117° 02' E; both genera). Specimens were compared with those in the TERC collection, and with the images from the ant web sites. The morphometric measurements described above were also obtained for the Chinese samples of *Iridomyrmex* (designated as sp. F; $n = 4$ workers).

2 Results

2.1 *Iridomyrmex anceps*

The two Australian species show morphometric differentiation, including where their ranges overlap, with the head of sp. B being broader for any given length (Fig. 4a). There are very marked differences among the five species in relative scape length, including within pairs of species with overlapping ranges (e.g. sp. A and sp. B in northern Australia, sp. D and sp. E in South-east Asia; (Fig. 4b, Fig. 5). Relative scape length is the same for the two Timor species (sp. C and sp. D), but sp. C is readily distinguished from all the other taxa we have seen by its extreme hairiness, including numerous hairs on the sides of its head (Fig.1). Notably, there is not a geographic gradient in relative scape length, with long scapes occurring in both the southern (sp. A) and northern (sp. F) limits of the species-complex range, and very short scapes (sp. E) occurring within the range of much longer scapes (sp. D). The Chinese samples (sp. F) have relatively long scapes, midway between sp. A and sp. B (Fig. 5).

Iridomyrmex has been collected widely in the Oriental biogeographic zone of southwestern China as far west as Yunnan Province and north into the Palearctic zone in Hebei Province (Fig. 6a).

2.2 *Ochetellus glaber*

The images of specimens presented as *O. glaber* on websites display interspecific levels of variation in antennal scape length, level of punctation on the head, pilosity, and body color (Fig. 7). The first species (Fig. 7 a, b) is from New Zealand, and has been well-documented as an introduction (Don 2007). It appears to match the densely punctate species from the Sydney region (Fig. 3c, d), and therefore may be true *O. glaber*. The Japanese species (Fig. 7c, d), has a shiny integument, short scapes (failing to reach vertexal margin) and erect hairs on the head and gaster (Japanese Ant Database Group 2003). The Japanese species was formerly known as *O. itoi* Forel, but was recently synonymized by Wu and Wang (1995). The third species (Fig. 7e, f) is from the USA, and appears to match *O. glaber clarithorax* Forel, which is native to coastal northern New South Wales and southern Queensland (TERC collection records). It is often associated with human settlements within its native range (A. N. Andersen, unpublished observations). *Ochetellus* has been recorded throughout the Oriental biogeographic zone of southeast China (Fig. 6b), as far west as Yunnan Province and as far north into the Palearctic zone as Shandong and Shaanxi Provinces. The specimens we collected from Longyan in Fujian Province (Fig. 8) are clearly different from the Japanese species previously known as *O. itoi* (Fig. 7c, d), and is not a close match to any other specimens in the photographs provided.

3 Discussion

We have provided clear evidence that the ‘tramp’ ant species *I. anceps* and *O. glaber* are both instead unresolved species complexes. There seems to be particularly high diversity of species referred to as *I. anceps* outside Australia. The specimen on Antweb identified as *I. anceps* from the Society Islands in French Polynesia (Fig. 9) appears to represent a different species to any of those addressed here, given its very broad and hairy head and short antennal

segments (indeed, it is uncertain that it even belongs to the *I. anceps* complex). We are unaware of which taxa the subspecies described from Fiji (*I. anceps ignoblis*), Burma (*I. anceps watsonii*), and India (*I. anceps sikkimensis*) refer to. However, given the diversity we have described in species referred to as *I. anceps*, it is very possible that one or more represent additional species. We find it regrettable that the most recent review of *Iridomyrmex* (Heterick and Shattuck, 2011) synonymised all described subspecies without any systematic analysis, quantitative or qualitative.

There has been similar taxonomic confusion with other tramp ant species in the Indo-Pacific region. For example, ants referred to as *Nylanderia* (previously *Paratrechina*) *vaga* very likely represent a complex of species, with the distribution of true *N. vaga* being highly uncertain (LaPolla et al., 2010). Such taxonomic confusion has recently been resolved for *Cardiocondyla nuda* (Seifert, 2003) and *Technomyrmex albipes* (Bolton, 2007), both with a long history of misidentification and having a far more limited distribution than previously believed.

Given such taxonomic confusion, many identifications of these commonly reported ants are likely to be unreliable and thus many claims of exotic status for *I. anceps* and *O. glaber* are questionable. *Ochetellus* has clearly been introduced outside its native range, but this appears to have occurred for at least two species, and it is not certain that either is *O. glaber*. The species formerly referred to as *O. itoi* does not match any known Australian species, is almost certainly not *O. glaber*, and is very likely native to Japan. The situation is even more confused for *I. anceps*. The distributional range of the *I. anceps* complex is continuous within the Indo-Pacific region to which it is restricted (Heterick, Shattuck 2011), and so it is uncertain if it is introduced anywhere. The one case where its introduction has been well-substantiated (in New Zealand) has proven to be a misidentification (Don 2007).

What does this mean for the status of *I. anceps* and *O. glaber* in China? Our conclusion is that both are very likely to be native Chinese species. The fact that they were well recorded in general Chinese collections at the beginning of the 20th century (Wheeler, 1922, 1927; Forel, 1912), are thoroughly distributed throughout the Oriental biogeographic zone, as well as considered by Chinese taxonomists to be native (Wu and Wang, 1995) supports this view. We would certainly recommend against any management action aimed at controlling these species under the assumption that they are exotic.

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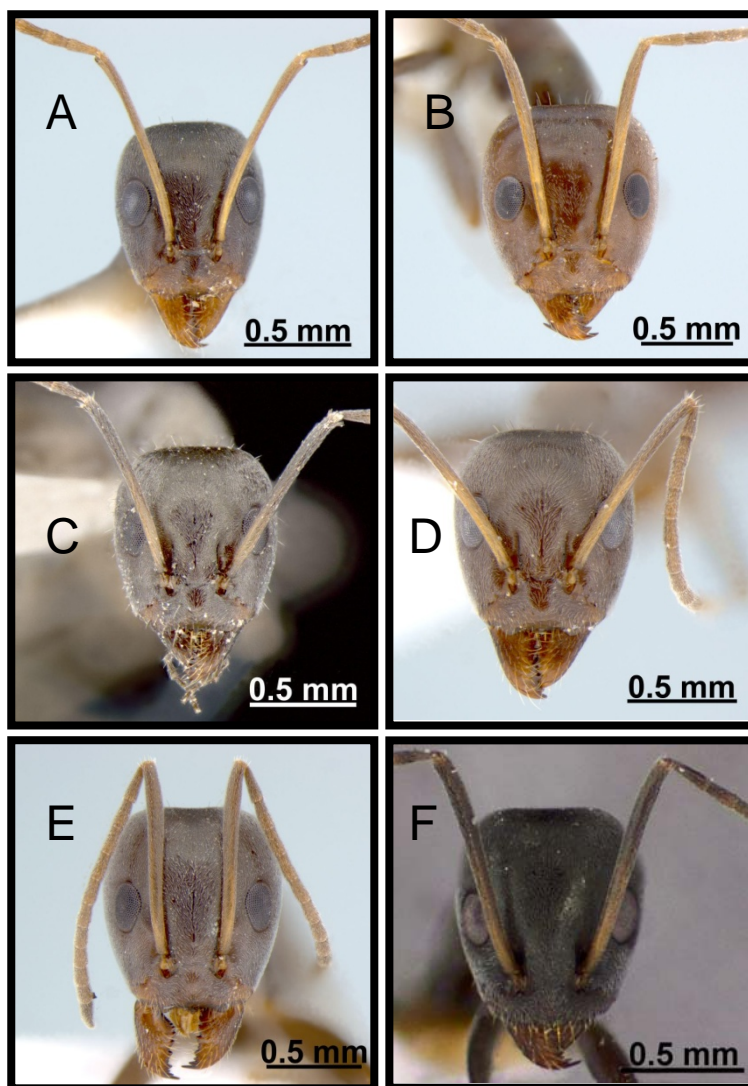


Fig.1 Images of the five species of the *Iridomyrmex anceps* complex addressed here (A = sp. A from Darwin, Northern Territory; B = sp. B from North Queensland; C = sp. C from Timor; D = sp. D from Timor; E = sp. E from Singapore), as well as a specimen from China (F = sp. f).

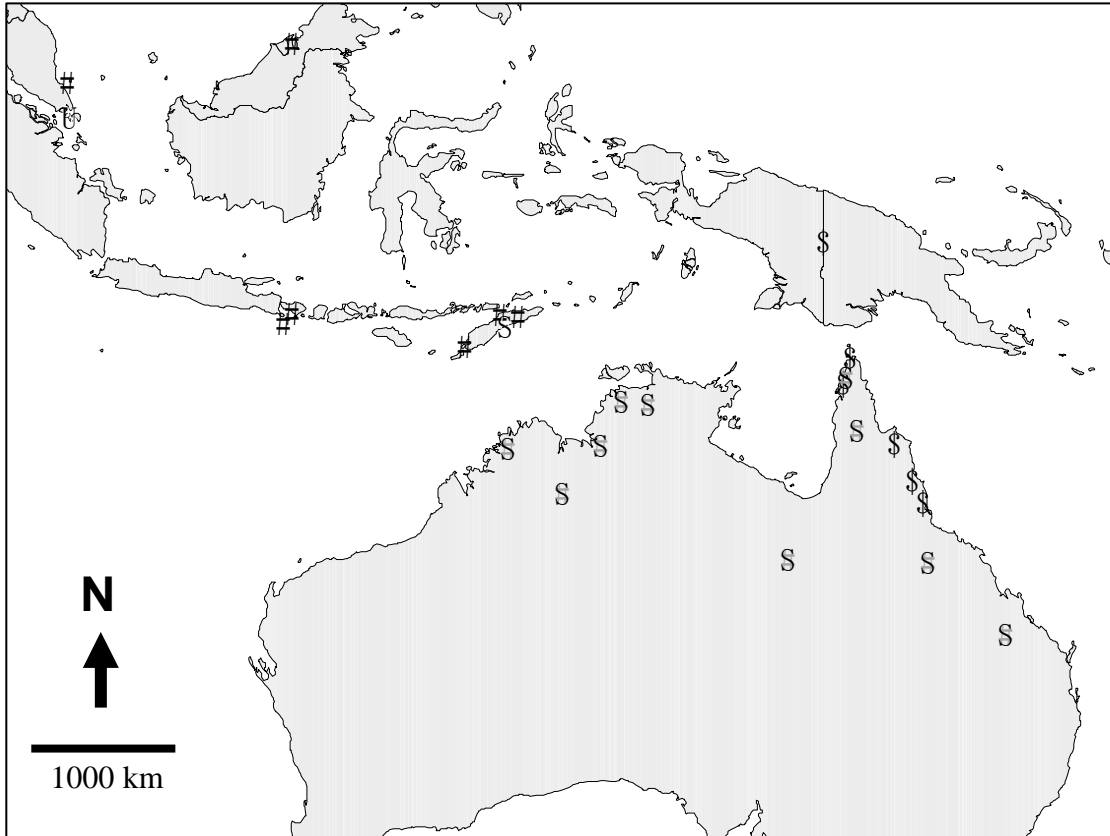


Fig.2 Collection locations of species from the *Iridomyrmex anceps* complex used for morphometric analyses: sp. A (gray circles); sp. B (black triangles); sp. C (white circle); sp. D (black circles); and sp. E (white square)



Fig.3 Two species from the *Ochetellus glaber* complex from the Sydney region

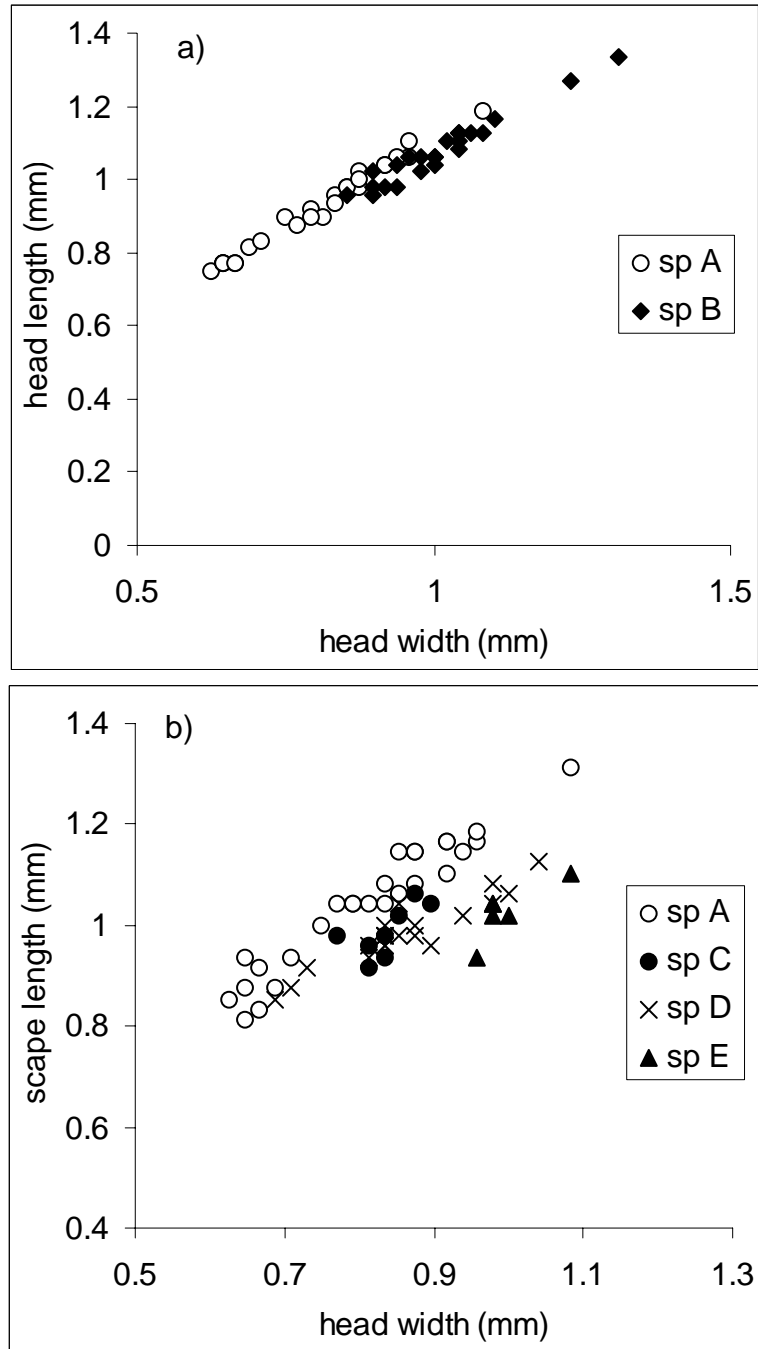


Fig. 4 Morphometric measurements for five species of the *Iridomyrmex anceps* complex, being relationships between a) head width and head length for two sympatric Australian species (species A and B), and b) head width and scape length for one Australian species (sp A) and three Asian species (species C–E)

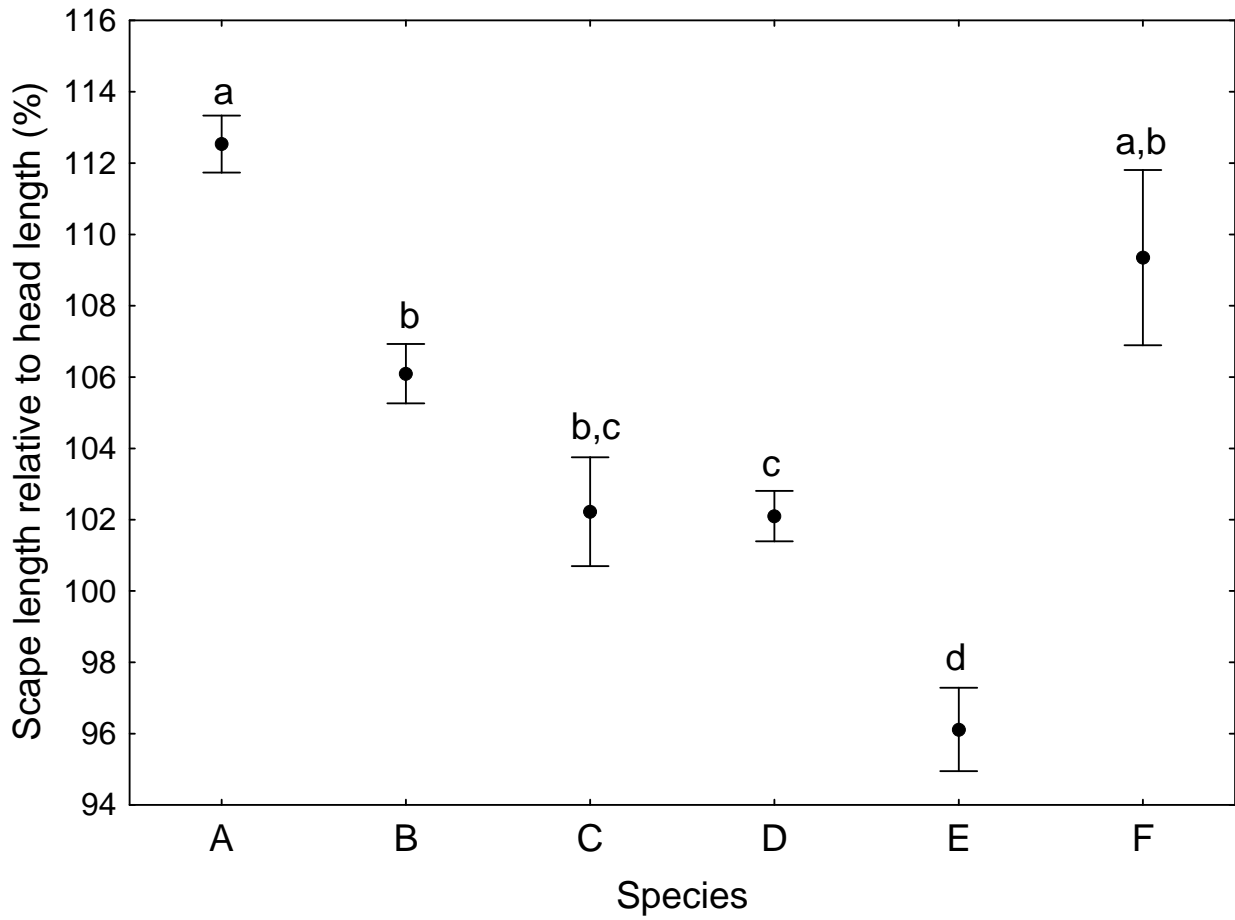


Fig. 5 Mean ($\pm SE$) scape length relative to head length for five species of the *Iridomyrmex anceps* complex (sp. A – sp. F) as well as for Chinese specimens (sp. F)

Different letters represent statistically significant differences found in post-hoc comparison of means using Tukey HSD Test (One-Way ANOVA: $F_{5, 86}=30.19, P<0.001$).

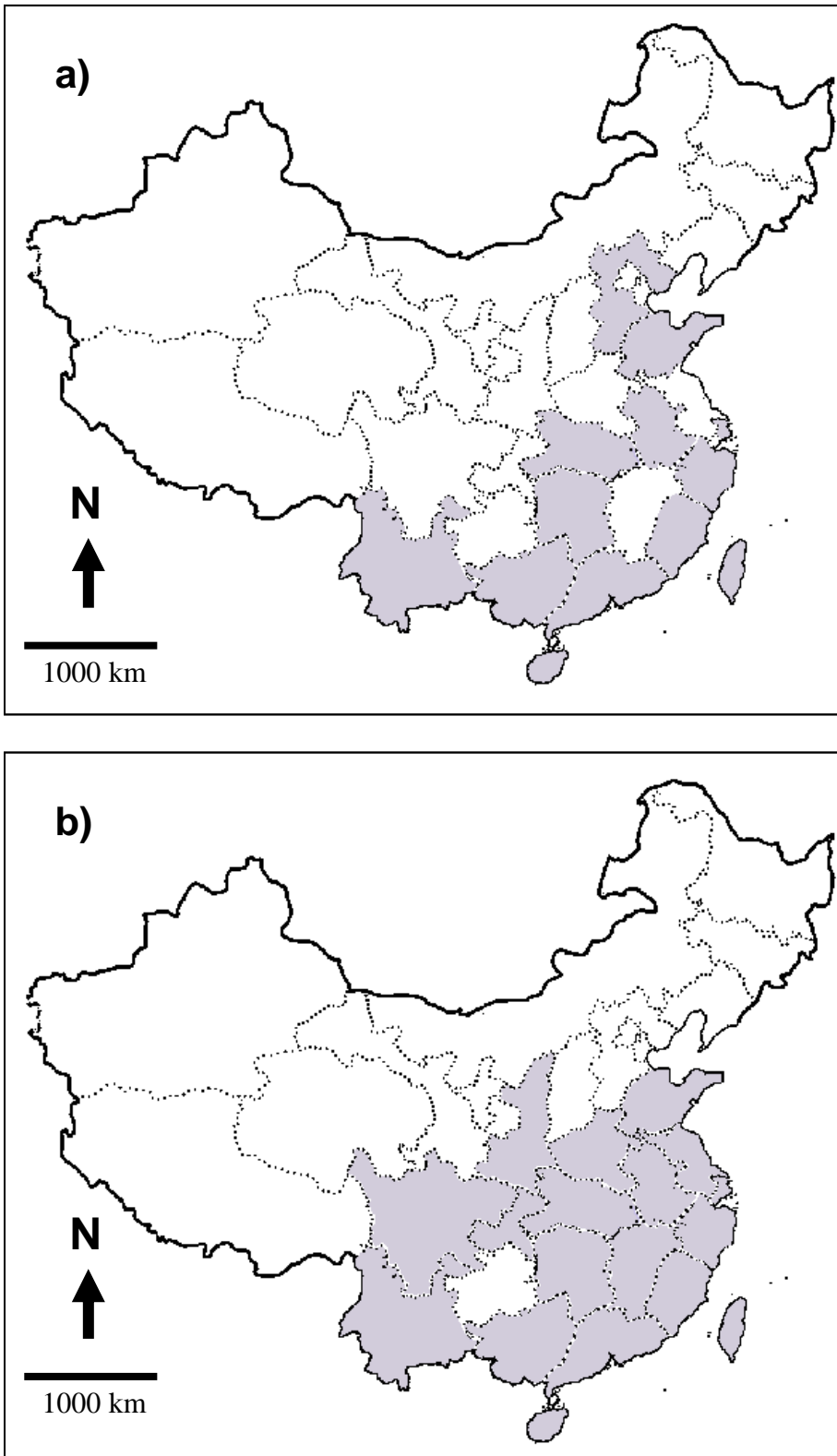


Fig. 6 Provincial-level distribution of *Iridomyrmex* (a) and *Ochetellus* (b) within China
Presence is indicated by gray shading.

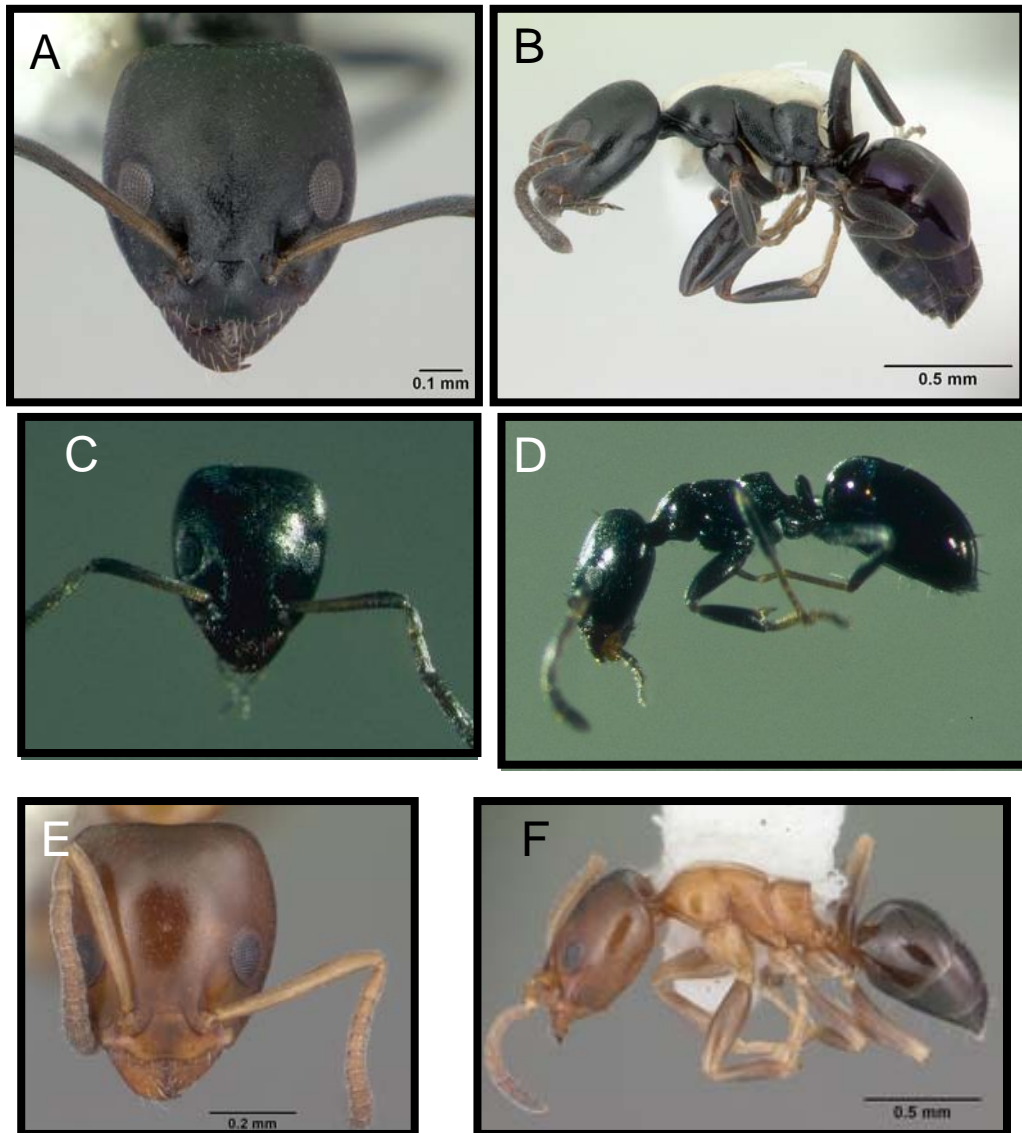


Fig. 7 Specimens identified as *Ochetellus glaber* from New Zealand (A, B; AntWeb, photographer Erin Prado), Japan (C, D; Japanese Ant Image Database, photographer unknown), and Florida, USA (E-F; AntWeb, photographer April Nobile)

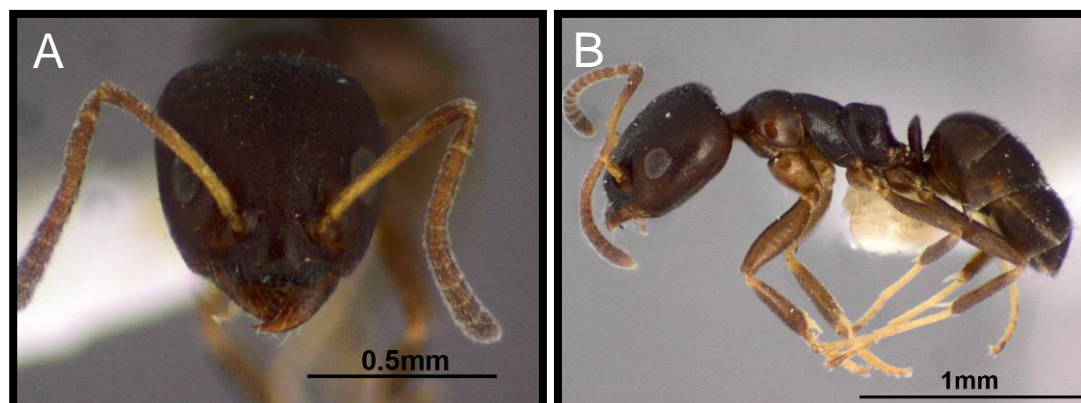


Fig. 8 *Ochetellus* specimen collected from Longyan, Fujian Province, China

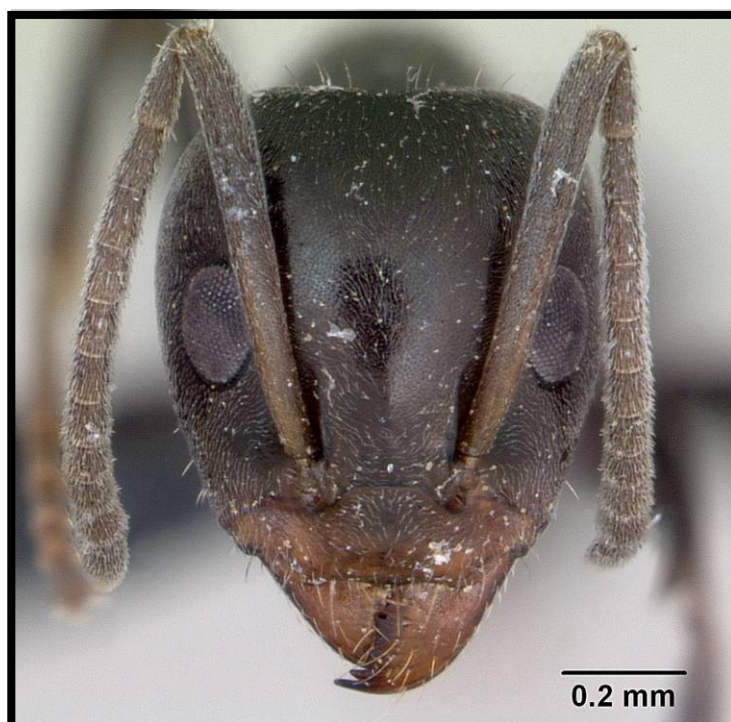


Fig. 9 Specimen identified as *Iridomyrmex anceps* on AntWeb from Mt Marau, Tahiti Island, Society Islands (photographer April Nobile)