

## Worldwide spread of *Cerapachys biroi* (Hymenoptera: Formicidae: Cerapachyinae)

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### Abstract

*Cerapachys biroi* FOREL, 1907 is a small, inconspicuous ant that has spread around the world through human commerce. To examine the worldwide distribution of *C. biroi*, we compiled and mapped specimen records from > 100 sites. We documented the earliest known *C. biroi* records for 24 geographic areas (countries and island groups), including several for which we found no previously published records: Comoro Islands, Guadeloupe, Îles Éparses, Indonesia, Madagascar, the Seychelles, Turks & Caicos Islands, and the US Virgin Islands.

All continental records of *Cerapachys biroi* come from Asia, where populations show notable geographic variation in morphology, suggesting that the species is native to this region. Conversely, the lack of obvious morphological variation among *C. biroi* specimens from outside mainland Asia suggests that *C. biroi* is exotic to these regions. Outside Asia, all records of *C. biroi* come from islands, possibly due to reduced competition with dominant ants in island habitats. Perhaps the many dominant native and exotic ant species in continental regions have prevented widespread establishment of *C. biroi*.

**Key words:** Biogeography, biological invasion, exotic species, island fauna.

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### Introduction

Numerous tramp ant species, spread by human commerce, have achieved broad cosmopolitan distributions. Some, such as *Linepithema humile* (MAYR, 1868) and *Solenopsis invicta* BUREN, 1972, have become great pests outside their native range. Most tramp ant species, however, have remained largely unnoticed. One unobtrusive tramp ant species, with no known impacts as an agricultural pest or human health hazard, is *Cerapachys biroi* FOREL, 1907 (Cerapachyinae). WILSON & TAYLOR (1967) wrote that *C. biroi* "is probably a pantropical tramp species, although certainly one of the most inconspicuous and seldom collected of this class."

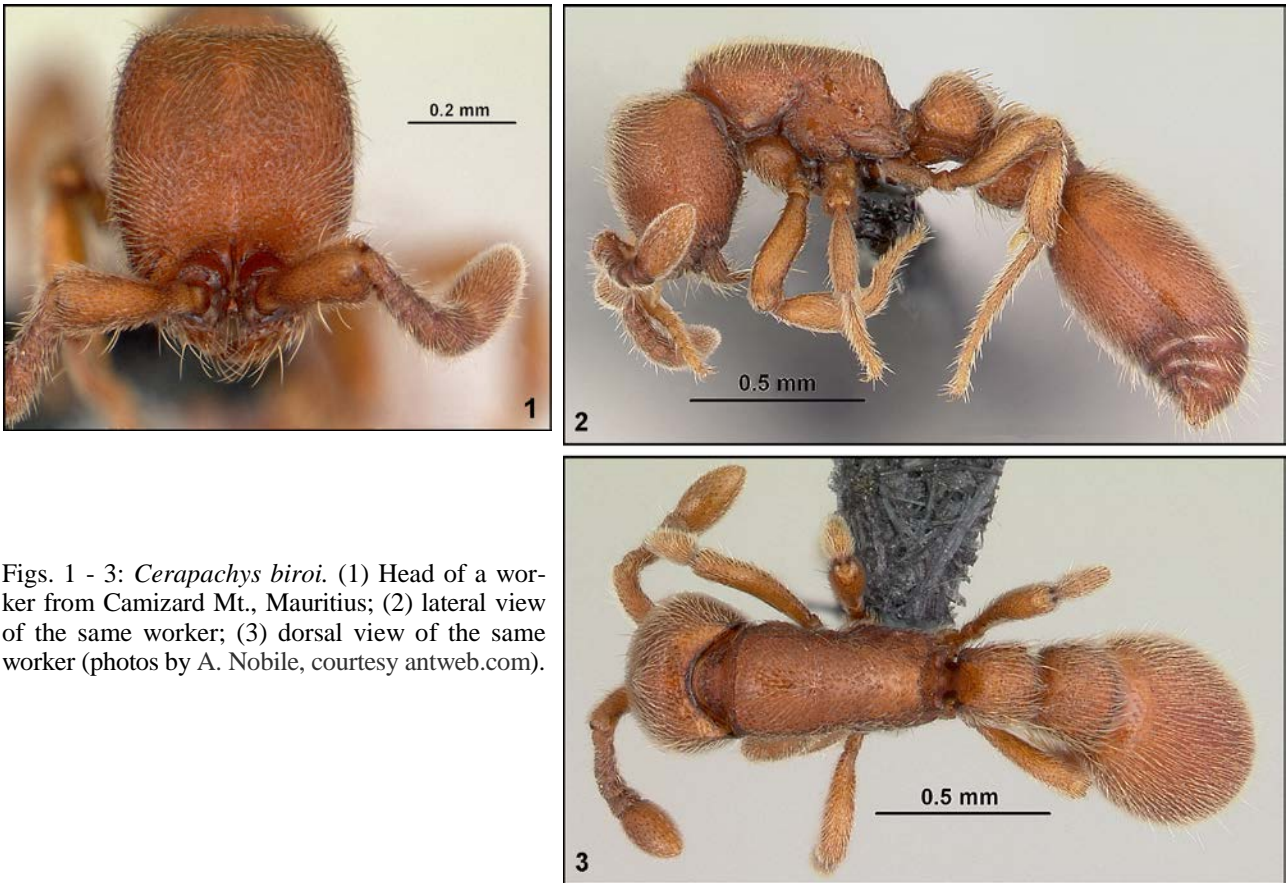
*Cerapachys biroi* has small colonies, typically consisting of a few hundred workers. Workers are only 2 - 3 mm in size and are entirely subterranean. *Cerapachys biroi* feeds primarily on the brood of other ants (TSUJI & YAMAUCHI 1995), but also may consume the soft-bodied larvae of other insects (WOLCOTT 1948). *Cerapachys* workers have heavily sclerotized cuticle that protects them against attack or injury when raiding the broods of other ants (HÖLLDOBLER 1982).

The reproductive cycle of *Cerapachys biroi* is similar to that of some army ants in that *C. biroi* colonies produce

brood in distinct cohorts, synchronized with cycles of alternating stately and nomadic phases (RAVARY & JAISSON 2002, RAVARY & al. 2006). *Cerapachys biroi* has received particular attention because, unlike most ants, all workers can produce diploid eggs through thelytokous parthenogenesis, although workers differ in their number of ovaries and their potential reproductive output (TSUJI & YAMAUCHI 1995, RAVARY & JAISSON 2004, LECOUTEY & al. 2011). This means that any colony fragment can theoretically found a new population. It is possible that this method of reproduction has facilitated the spread of *C. biroi* around the world. Here, we compiled and mapped specimen records of *C. biroi* to document its worldwide spread.

### Taxonomy

*Cerapachys* comes from Greek for "thick-horn", referring to the thick antennae of ants in this genus, possibly an adaptation against being severed when attacked by other ants (Figs. 1 - 3). FOREL (1907) described *C. biroi* from Singapore, naming it after Lajos Biró, the Hungarian naturalist who collected the type specimens. Junior synonyms include: *Cerapachys silvestrii* WHEELER, 1909 (Hawaii), *Cerapachys sinensis* WHEELER, 1928 (China), *Cerapachys*



Figs. 1 - 3: *Cerapachys biroi*. (1) Head of a worker from Camizard Mt., Mauritius; (2) lateral view of the same worker; (3) dorsal view of the same worker (photos by A. Nobile, courtesy antweb.com).

*seini* MANN, 1931 (Puerto Rico) and *Cerapachys ierensis* WEBER, 1939 (Trinidad). Outside mainland Asia, *C. biroi* populations show little morphological variation. In contrast, there is some variation (e.g., in pilosity, shape of subpetiolar process) among samples from different parts of Asia. Nonetheless, based on an ongoing taxonomic revision (MLB, unpubl.), we treat these Asian forms as a single

species. BROWN (1975) considered the native range of *C. biroi* to include Nepal and central China to Southeast Asia.

#### Materials and Methods

Using published and unpublished records, we documented the worldwide range of *Cerapachys biroi*. We obtained unpublished site records from museum specimens in the

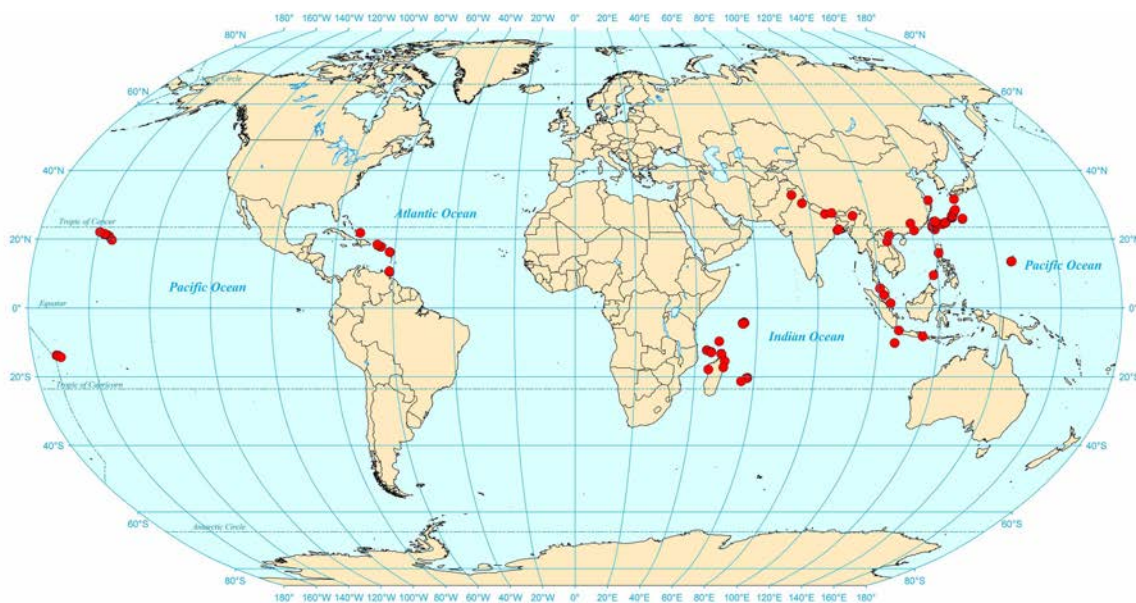


Fig. 4: Worldwide distribution records of *Cerapachys biroi*.

Tab. 1: Earliest known records for *Cerapachys biroi*, giving collection locales for museum specimens. + = no previously published records. MCZ = Museum of Comparative Zoology, BMNH = Natural History Museum, London, CAS = California Academy of Sciences, MLB = M.L. Borowiec collection.

Asia	Earliest record
Singapore	≤ 1907 (FOREL 1907)
China	≤ 1928 (WHEELER 1928 as <i>C. sinensis</i> )
India	1943 (L. Weatherill, MCZ): Baigachi, West Bengal
Japan	1945 (WILSON & TAYLOR 1967 as <i>S. silvestrii</i> )
Malaysia	1946 (G.H. Lowe, BMNH): Patani
Nepal	1956 (WILSON & TAYLOR 1967 as <i>S. silvestrii</i> )
Taiwan	1982 (TERAYAMA & al. 1988)
Philippines	≤ 1998 (WAY & al. 1998)
+ Indonesia	1998 (I.K.T. Ginarsa, MLB): West Bali
Vietnam	1999 (EGUCHI & al. 2005)
Pacific	
Hawaii	≤ 1909 (WHEELER 1909 as <i>C. silvestrii</i> )
Mariana Islands	1936 (SWEZEY 1942)
Samoa	1956 (WILSON & TAYLOR 1967 as <i>S. silvestrii</i> )
Indian Ocean	
Mascarene Islands	1954 (R. Mamet, BMNH): Pont Colville, Mauritius
+ Madagascar	1977 (W.L. Brown, BMNH): Nosy Mangabe
Christmas Island	≤ 1990 (TAYLOR 1990 in FRAMENAU & THOMAS 2008)
+ Seychelles	2001 (J. Gerlach, CAS): La Passe, Silhouette
+ Îles Éparses	2007 (B.L. Fisher & al., CAS): Mont Combani, Mayotte
+ Comoro Islands	2009 (B.L. Fisher & al., CAS): Lac Boundouni, Mohéli
West Indies	
Puerto Rico	1930 (MANN 1931 as <i>C. seini</i> )
Trinidad	1935 (WEBER 1939 as <i>C. ierensis</i> )
+ USVI	2005 (J.K. Wetterer, MCZ): Prosperity, St Croix
+ Guadeloupe	2008 (J.K. Wetterer, MCZ): Oile du Parc
+ Turks & Caicos Is.	2010 (J.K. Wetterer, MCZ): Club Med, Providenciales

collections of the Museum of Comparative Zoology (MCZ), the Natural History Museum, London (BMNH), the Muséum National d'Histoire Naturelle, Paris (MNHN), the

California Academy of Sciences (CAS), and the University of California at Davis (UCD). In addition, we used on-line databases with collection information on specimens by Antweb (www.antweb.org), and the Global Biodiversity Information Facility (www.gbif.org). We received unpublished records from T. Wong (China), Z. Shanyi (China), F. Ravary (Japan: collected by Tsuji & al., Taiwan: collected by Chung-Chi & al.), K. Eguchi (Vietnam), G.M. Dlussky (Samoa), and H. Bharti (India). Finally, we collected *C. biroi* specimens on islands of the West Indies and Okinawa.

We obtained geo-coordinates for collection sites from published references, specimen labels, maps, or geography web sites (e.g., earth.google.com, www.tageo.com, and www.fallingrain.com). If a site record listed a geographic region rather than a "point locale", and we had no other record for this region, we used the coordinates of the largest town within the region or, in the case of small islands and natural areas, the center of the region. Published records usually included collection dates. In a number of cases, publications did not include the collection dates for specimens, but we were able to determine the approximate date based on information on the collector's travel dates or limit the date by the collector's date of death.

## Results

We compiled *Cerapachys biroi* specimen records from > 100 sites worldwide (Fig. 4). MLB examined specimens from most of these sites. We documented the earliest known *C. biroi* records for 24 geographic areas (countries and island groups; Tab. 1), including several for which we found no previously published records: Comoro Islands, Guadeloupe, Îles Éparses, Indonesia, Madagascar, the Seychelles, Turks & Caicos Islands, and the US Virgin Islands.

MLB determined two records listed on the web as this species (from Palau and the Seychelles) to be other species. The only geographic areas we list (Tab. 1) for which we did not secure definitive specimen identifications were Christmas Island and the Philippines.

## Discussion

*Cerapachys biroi* is primarily known from the tropics, but there are a few subtropical records from Japan, China, and Nepal (Fig. 4). The highest latitude records come from Kagoshima, Japan (31.6° N) and Shanghai, China (31.2° N).

Continental Asian records of *Cerapachys biroi* range from northern India through Nepal and Bangladesh to southern China and Vietnam. The greatest morphological diversity of *C. biroi* occurs in continental Asia (MLB, unpubl.), supporting BROWN's (1964) assertion that this species is native to this region. Conversely, the lack of morphological variation among *C. biroi* specimens from outside Asia suggests that *C. biroi* is exotic to these regions. Interestingly, outside Asia, all records of *C. biroi* come from islands, possibly due to reduced competition with dominant ants in island habitats. Perhaps the many dominant native and exotic ant species in continental regions have prevented widespread establishment of *C. biroi*.

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