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EXOTIC ANTS (HYMENOPTERA: FORMICIDAE) OF CAMBODIA

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Summary. In this study, we reports ten exotic ant species from Cambodia, based on field expeditions conducted from 2010 to 2013. The following seven species are confirmed to be new to Cambodia: *Iridomyrmex anceps* (Roger, 1863), *Monomorium floricola* (Jerdon, 1851), *M. pharaonis* (Linnaeus, 1758), *Solenopsis geminata* (Fabricius, 1804), *Tetramorium kheperra* (Bolton, 1976), *T. lanuginosum* Mayr, 1870 and *Trichomyrmex destructor* (Jerdon, 1851). Distributional data are also given at the province level.

Key words: Dolichoderinae, Formicinae, Myrmicinae, fauna, invasive species, Southeast Asia.

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Резюме. По результатам экспедиций в 2010–2013 гг. из Камбоджи приводятся 10 экзотических видов муравьев. Впервые для страны указаны 7 видов: *Iridomyrmex anceps* (Roger, 1863), *Monomorium floricola* (Jerdon, 1851), *M. pharaonis* (Linnaeus, 1758), *Solenopsis geminata* (Fabricius, 1804), *Tetramorium kheperra* (Bolton, 1976), *T. lanuginosum* Mayr, 1870 и *Trichomyrmex destructor* (Jerdon, 1851). Приводятся сведения о распространении этих видов по провинциям Камбоджи.

INTRODUCTION

Exotic ants have a significant ecological impact and serious concerns for human health (Angulo *et al.*, 2022). In recent years, exotic ants have been introduced worldwide through global transfers and human activities. Reliable and traceable collection records, including locality, date, collector name, coordinates, and depository institute provide a basic information for effective pest control management in the future. Thus, the lists of exotic ants have been extensively improved in several countries and areas (Deyrup *et al.*, 2000; Wetterer *et al.*, 2004; Gómez & Espadaler, 2006; Boer & Vierbergen, 2008; Ivanov, 2016; Wetterer, 2017; Taheri & Reyes-López, 2018; Schifani, 2019; Rosas-Mejía *et al.*, 2021).

In Southeast Asia, exotic ants have been represented in taxonomic revisions, checklists, faunal reports, and ecological studies (e.g., Eguchi *et al.*, 2014 for Vietnam; Hosoishi *et al.*, 2017 for Cambodia; Jaitrong *et al.*, 2016 for Laos; Khachonpisitsak *et al.*, 2020 for Thailand). Jaitrong *et al.* (2016) represented 123 ant species from Laos and included 10 exotic species, while Khachonpisitsak *et al.* (2020) represented 529 valid species from Thailand and included 14 exotic species. A few exotic ants have been reported from Cambodia (Hosoishi *et al.*, 2012, 2013, 2017, 2018), but no summary of exotic ant species records exists. Currently, 90 named ant species are known from Cambodia (Antwiki, 2022) and three species, *Anoplolepis gracilipes* (Smith, 1857), *Tapinoma melanocephalum* (Fabricius, 1793) and *Technomyrmex albipes* (F. Smith, 1861) are considered exotic species. Here, we present the results of ant surveys conducted during 2010–2013 in Cambodia. In the field expeditions, the first author (SH) visited Kampong Cham, Kampong Chhnang, Kampong Thom, Kampot, Koh Kong, Ratanakiri, and Siem Reap provinces. This study is based on data gathered from the expeditions conducted between 2010 and 2013.

In this study, we generally followed the list of ‘exotic ants’ provided by Schultz & McGlynn (2000), but also followed the recent checklist in Thailand (Khachonpisitsak *et al.*, 2020).

MATERIAL AND METHODS

Specimens used in this study were collected during expeditions in Cambodia under the Memorandum of Understanding (MOU) between Japan and Cambodia, Kyushu University, Japan and the Forestry Administration, Cambodia, on cooperation concerning biological resources and information. The materials are shared between Cambodia and Japan, but the present materials are deposited in Japan, on indefinite loan from Cambodia. The specimens were examined and/or deposited in the Institute of Tropical Agriculture, Kyushu University, Fukuoka, Japan (KUEC). All of the specimens examined in this study have been collected by S. Hosoishi.

Ant specimens were collected from primary forests, regrowth forests, community forests, and rubber plantations in Cambodia during 2010–2013. Ants from leaf litter were collected by Winkler extraction, arboreal ants by time unit sampling. Ants were also collected by hand collecting on the ground, lower vegetation, inside dead twigs, when nest series are available (e.g., SH10-Cam-191).

Images were taken using a Canon EOS 50D with a Canon MP-E 65 mm 1–5 Macro lens, then processed using Combine ZM (Hadley, 2010).

All specimens were identified to genus using Bolton (1994) and identified to species level if the key is available. The species distributions in the maps are based on our records at the province level (Fig. 1).

LIST OF SPECIES

Subfamily Dolichoderinae

Iridomyrmex anceps (Roger, 1863)

Fig. 2

MATERIAL EXAMINED. **Cambodia:** Kampong Thom, secondary forest, 12°40' N, 105°17' E, 26.XI 2010, 4 workers, S. Hosoishi leg. (SH10-Cam-191); Kampot, Bokor National Park, 10°39' N, 104°03' E, 22.XII 2011, 17 workers, S. Hosoishi leg.

DISTRIBUTION IN CAMBODIA. Kampong Thom, Kampot.

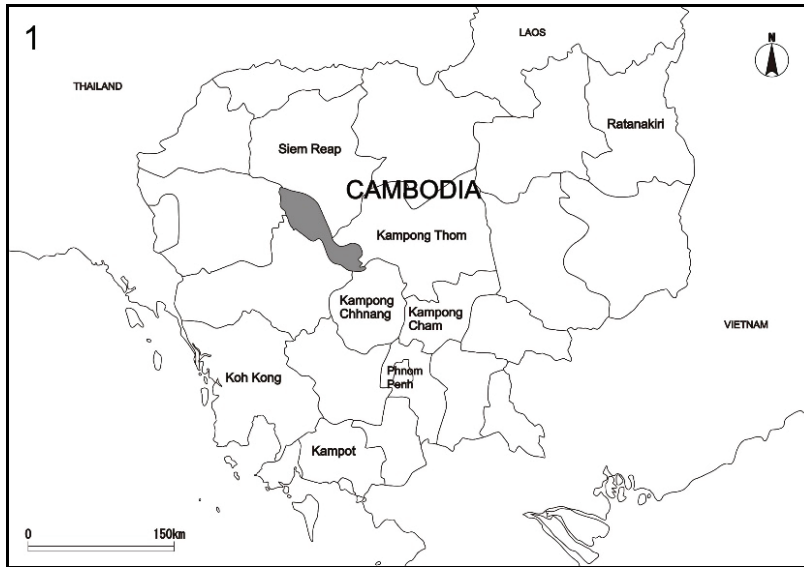


Fig 1. Map of the collecting locality.

***Tapinoma melanocephalum* (Fabricius, 1793)**

Fig. 3

MATERIAL EXAMINED. Cambodia: Kampong Cham, rubber plantation, 11°57' N, 105°34' E, 30.IV 2010, 8 workers, S. Hosoishi leg. (time unit sampling); Kampong Chhnang, community forest, 11°59' N, 104°44' E, 21.IV 2010, 8 workers, S. Hosoishi leg. (Winkler extraction); Kampong Thom, natural forest, 12°34' N, 105°23' E, 19.XI 2010, 2 workers, S. Hosoishi leg. (time unit sampling); Siem Reap, Local FA plots, 13°43' N, 104°02' E, 12.XII 2012, 4 workers, S. Hosoishi leg. (time unit sampling).

DISTRIBUTION IN CAMBODIA. Kampong Cham, Kampong Chhnang, Kampong Thom, Siem Reap.

***Technomyrmex albipes* (F. Smith, 1861)**

Fig. 4

MATERIAL EXAMINED. Cambodia: Kampong Thom, natural forest, 12°34' N, 105°21' E, 10.I 2010, 3 workers, S. Hosoishi leg. (SH10-Cam-24); Kampong Thom, natural forest, 12°34' N, 105°21' E, 21.XI 2010, 1 worker, S. Hosoishi leg. (time unit sampling).

DISTRIBUTION IN CAMBODIA. Kampong Thom.

Subfamily Formicinae

***Anoplolepis gracilipes* (Smith, 1857)**

Fig. 5

MATERIAL EXAMINED. Cambodia: Kampong Cham, rubber plantation, 11°57' N, 105°34' E, 30.IV 2010, 7 workers, S. Hosoishi leg. (time unit sampling); Kampong Chhnang,

community forest, 11°59' N, 104°44' E, 21.IV 2010, 5 workers, S. Hosoishi leg. (time unit sampling); Kampong Thom, natural forest, 12°34' N, 105°23' E, 11.I 2010, 9 workers, S. Hosoishi leg. (SH10-Cam-47); Kampot, Bokor National Park, 10°36' N, 104°05' E, 15.V 2012, 4 workers, S. Hosoishi leg. (time unit sampling); Siem Reap, Local FA plots, 13°43' N, 104°02' E, 12.XII 2012, 3 workers, S. Hosoishi leg. (time unit sampling).

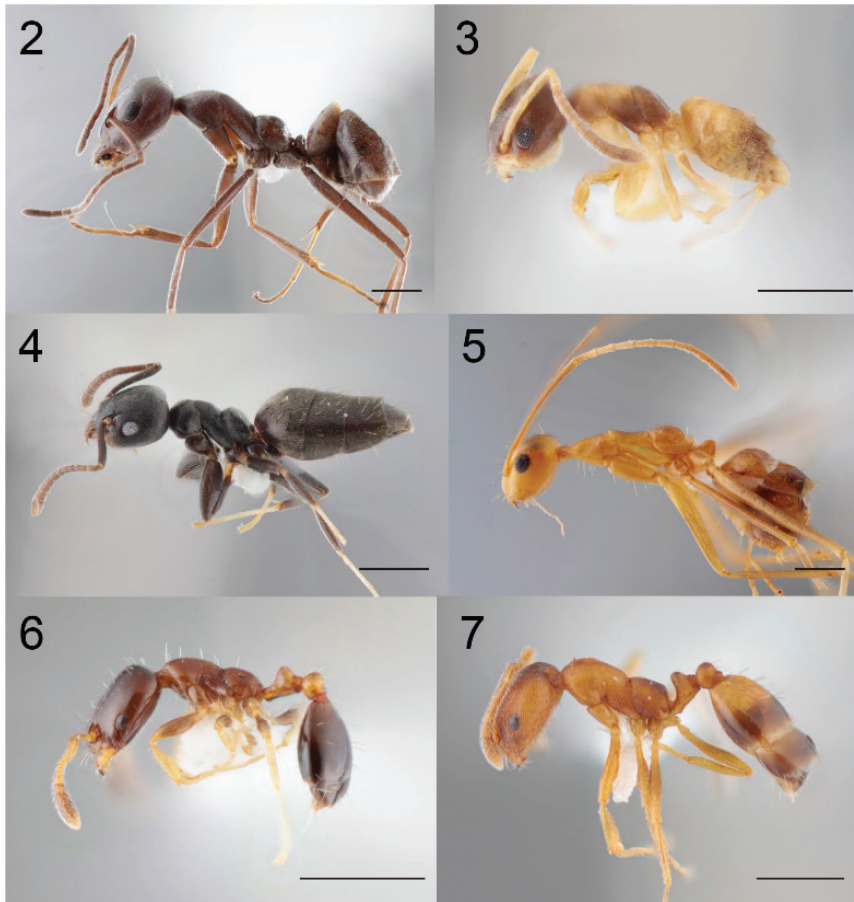
DISTRIBUTION IN CAMBODIA. Kampong Cham, Kampong Chhnang, Kampong Thom, Kampot, Siem Reap.

Subfamily Myrmicinae

Monomorium floricola (Jerdon, 1851)

Fig. 6

MATERIAL EXAMINED. **Cambodia:** Kampong Cham, rubber plantation, 11°57' N, 105°34' E, 30.IV 2010, 7 workers, S. Hosoishi leg. (time unit sampling); Kampong Chhnang,



Figs 2–7. Exotic ants in Cambodia. 2 – *Iridomyrmex anceps*; 3 – *Tapinoma melanocephalum*; 4 – *Technomyrmex albipes*; 5 – *Anoplolepis gracilipes*; 6 – *Monomorium floricola*; 7 – *Monomorium pharaonis*. Scale bars = 0.5 mm.

community forest, 11°59' N, 104°44' E, 27.IV 2010, 1 worker, S. Hosoishi leg. (time unit sampling); Kampong Thom, natural forest, 12°34' N, 105°23' E, 21.XI 2010, 3 workers, S. Hosoishi leg. (SH10-Cam-158); Siem Reap, Local FA plots, 13°43'47" N, 104°02'38" E, 12.XII 2012, 3 workers, S. Hosoishi leg. (time unit sampling).

DISTRIBUTION IN CAMBODIA. Kampong Cham, Kampong Chhnang, Kampong Thom, Siem Reap.



Figs 8–11. Exotic ants in Cambodia (continued). 8 – *Solenopsis geminata*; 9 – *Tetramorium kheperra*; 10 – *Tetramorium lanuginosum*; 11 – *Trichomyrmex destructor*. Scale bars = 0.5 mm.

***Monomorium pharaonis* (Linnaeus, 1758)**

Fig. 7

MATERIAL EXAMINED. **Cambodia:** Kampong Cham, rubber plantation, 11°57' N, 105°34' E, 30.IV 2010, 2 workers, S. Hosoishi leg. (Winkler extraction); Kampong Chhnang, community forest, 11°59' N, 104°44' E, 22.IV 2010, 7 workers, S. Hosoishi leg. (Winkler extraction); Kampong Thom, natural forest, 12°36' N, 105°16' E, 24.XI 2010, 2 workers, S. Hosoishi leg. (SH10-Cam-174); Kampot, Bokor National Park, 10°36' N, 104°06' E, 19–21.XII 2011, 1 worker, S. Hosoishi leg. (Winkler extraction); Siem Reap, Local FA plots, 13°43' N, 104°02' E, 13.XII 2012, 6 workers, S. Hosoishi leg. (dead twig).

DISTRIBUTION IN CAMBODIA. Kampong Cham, Kampong Chhnang, Kampong Thom, Kampot, Siem Reap.

***Solenopsis geminata* (Fabricius, 1804)**

Fig. 8

MATERIAL EXAMINED. **Cambodia:** Kampong Chhnang, community forest, 11°59' N, 104°44' E, 13.I 2010, 5 workers, S. Hosoishi leg. (SH10-Cam-64); Kampong Thom,

secondary forest, 12°40' N, 105°17' E, 26.XI 2010, 10 workers, S. Hosoishi leg. (SH10-Cam-188).

DISTRIBUTION IN CAMBODIA. Kampong Chhnang, Kampong Thom.

***Tetramorium kheperra* (Bolton, 1976)**

Fig. 9

MATERIAL EXAMINED. **Cambodia:** Kampong Thom, natural forest, 12°34' N, 105°23' E, 18.XI 2010, 1 worker, S. Hosoishi leg. (Winkler extraction); Kampot, Bokor National Park, 10°36' N, 104°05' E, 11–13.V 2012, 4 workers, S. Hosoishi leg. (Winkler extraction).

DISTRIBUTION IN CAMBODIA. Kampong Thom, Kampot.

***Tetramorium lanuginosum* Mayr, 1870**

Fig. 10

MATERIAL EXAMINED. **Cambodia:** Kampong Thom, secondary forest, 12°38' N, 105°16' E, 23.XI 2010, 3 workers, S. Hosoishi leg. (SH10-Cam-170).

DISTRIBUTION IN CAMBODIA. Kampong Thom.

***Trichomyrmex destructor* (Jerdon, 1851)**

Fig. 11

MATERIAL EXAMINED. **Cambodia:** Kampong Chhnang, community forest, 11°59' N, 104°44' E, 23.IV 2010, 10 workers, S. Hosoishi leg. (SH10-Cam-99); Kampong Chhnang, community forest, 11°59' N, 104°44' E, 27.IV 2010, 10 workers, S. Hosoishi leg. (SH10-Cam-107); Kampot, Bokor National Park, 10°37' N, 104°05' E, 9.XII 2011, 10 workers, S. Hosoishi leg. (SH11-Cam-17); Ratanakiri, 13°34' N, 106°55' E, 8.V 2013, 4 workers, S. Hosoishi leg.; Siem Reap, Local FA plots, 13°43' N, 104°02' E, 13.XII 2012, 10 workers, S. Hosoishi leg. (Dead twig).

DISTRIBUTION IN CAMBODIA. Kampong Chhnang, Kampot, Ratanakiri, Siem Reap.

DISCUSSION

This is the first comprehensive report of exotic ants in Cambodia. In total, ten exotic species are represented from Cambodia (Table 1). Compared to the exotic ant lists in the neighboring countries, it is likely that the actual number of exotic species is close. Although our sampling efforts were limited during the expeditions, we investigated several types of habitats, including natural forests, secondary forests, community forests, and rubber plantations in Cambodia.

The most frequently recorded species were *Monomorium pharaonis* (5 provinces), *Anoplolepis gracilipes* (5), *Tapinoma melanocephalum* (4) *Monomorium floricola* (4) and *Trichomyrmex destructor* (4). *Monomorium pharaonis* is not easy to find in large numbers in the field because of its relatively small size, but has been collected by Winkler extraction in this study. Whereas, *A. gracilipes* is active and easily collected by general collecting and time unit sampling. Our sampling methods employed general collecting, Winkler extraction, and time unit sampling. These combinations can collect cryptic species, active species, ground-dwelling, leaf litter, and arboreal species.

The province with the highest number of records was Kampong Thom (9 species). Kampong Thom is the second largest province and is located inland. The province does not face

the sea but has Tonle Sap Lake in the western area. It is beyond the scope of this study to infer the reason for the presence of so many exotic species, but might be due to sampling efforts in this region.

Table 1. Exotic ant species in Cambodia and neighboring countries.

Species	Origin	Countries				References
		I	II	III	IV	
DOLICHODERINAE						
<i>Iridomyrmex anceps</i>	Indo-Pacific	1	1	1	1	Heterick & Shattuck, 2011
<i>Ochetellus glaber</i>	Indo-Pacific		1		1	Deyrup <i>et al.</i> , 2000
<i>Tapinoma melacophalum</i>	Indo-Pacific	1	1	1	1	Wetterer, 2009
<i>Technomyrmex albipes</i>	Indo-Pacific	1	1	1	1	Wetterer, 2009
<i>Technomyrmex difficilis</i>	Unknown			1	1	Wetterer, 2013
FORMICINAE						
<i>Anoplolepis gracilipes</i>	Asia or Africa	1	1	1	1	Wetterer, 2005
MYRMICINAE						
<i>Monomorium floricola</i>	Asia	1	1	1	1	Wetterer, 2010a
<i>Monomorium pharaonis</i>	Asia or Africa	1	1	1	1	Wetterer, 2010b
<i>Pheidole megacephala</i>	Africa		1		1	Wetterer & Vargo, 2003
<i>Solenopsis geminata</i>	Neotropic	1	1	1	1	Wetterer, 2011
<i>Tetramorium kheperra</i>	Unknown	1			1	Yamane & Jaitrong, 2011
<i>Tetramorium lanuginosum</i>	Unknown	1	1	1	1	Wetterer, 2010c
<i>Trichomyrmex destructor</i>	Indian sub-continent	1		1	1	Deyrup <i>et al.</i> , 2000, Wetterer, 2009
<i>Vollenhovia emeryi</i>	Japan				1	Wetterer <i>et al.</i> , 2015
Total		10	10	10	14	

NOTE. I – Cambodia (our data); II – Vietnam (from Eguchi *et al.*, 2005, 2014; Yamane *et al.*, 2002); III – Laos (from Jaitrong *et al.*, 2016); IV – Thailand (from Khachonpisitsak *et al.*, 2020).

In Southeast Asia, Cambodia's primary forests have remained relatively unexploited (Save Cambodia's Wildlife, 2006). In recent years, however, these forests have been threatened by human activities, such as logging and commercial plantations. Increasing tourism development (e.g., casinos and hotels) in highland areas threatens the endemic pitcher

plants in Phnom Bokor National Park (May, 2009). Several exotic ant species, *I. anceps* and *T. melanocephalum* have been captured by pitcher plants at high frequencies (Hosoishi *et al.*, 2012). This suggests that exotic ants are common in such conserved mountainous areas. A list of exotic ants with locality and date will be useful for monitoring and pest control management in the future.

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